RABDOLOGIA:

OR,

The Art of numbring by Rods, whereby the tedious operations of Multiplication, and Diviſion, and of Extraction of Roots, both Square and Cubick, are avoided, being for the moſt part performed by Addition and Subſtraction:

WITH

Many Examples for the practiſe of the ſame: Firſt invented by the Lord *Napier*, *Baron* of *Marchiſton*, and ſince explained, and made uſefull for all ſorts of men.

By SETH PARTRIDGE, Surveyor, and Practitioner in the MATHEMATICKS.

LONDON,
Printed by *Robert White*, and are to be ſold by *John Partridge*, dwelling at the *Roſe* and *Crowne* at *Black-friers* Gate, neere *Carter Lane*. 1648.

g.° R. 84. Mod.

TO

The Right VVorſhipfull, Doctor *WRIGHT*, Dr. of *Phyſick*, theſe, with his other beſt *SERVICES*.

SIR,

AMongſt the many rare inventions that this laſt Age of the world hath produced, thoſe of the Lord *Napier*, Baron of *Marchiſton* in *Scotland*, may require the higheſt rank, of which

are that of his Logarithmes, and this of the Rods; for that of the Logarithmes, it was taught to ſpeake *Engliſh* by that ever famous Mathematition, Maſter *Edward Wright*; but for this of the Rods, though generally uſefull, it was never brought into *Engliſh*, nor any thing thereupon written in *Engliſh*, for ought that ever I could either ſee or heare of.

About nine or ten years agone, according to my dark and miſtie underſtanding in the *Latin* tongue, I collected out of the Lord *Napiers Latin* book, ſome rules and notes of the uſe of theſe Rods into *Engliſh*, for my own private uſe, ſince which time, ſomethat repaired to me for inſtruction in *Arithmetick*, and other parts of

of the Mathematicks, ſeeing the excellency of working by the Rods, importuned me to have Copies of my notes in *Engliſh*, and others of late, perſwaded me to publiſh the ſame in print, through which perſwaſions, and conſidering the great trouble of often tranſcribing the Copie, and alſo how ſubject errours are to creep in by ſo doing, I am incouraged to adventure to publiſh the ſame in print, for the uſe of all.

Now howſoever, being ſo rudely compoſed as it is (for I have had indeed no leiſure of late to poliſh it) and alſo being of ſo ſmall a Volume as it is, it may ſeeme unworthy your Patronage; yet through your continued favours towards

me, I am emboldened to preſent it to your Worſhips protection, deſiring only your acceptance, and pardon for my boldneſſe; which had, will be a ſufficient encouragement to me, to adventure the publike Stage, and ever remaine,

Your Worſhips

to ſerve you,

SETH PARTRIDGE.

To the Reader.

Iudicious and curteous Readers (for to ſuch I only ſpeak) who are (I know) of that plauſible ſpirit, grave and ſolid judgements, that in reading applaud that which is good, in whomſoever they finde it to be, and paſſe over in ſilence that which is not hurtfull to any, without contemning either the worke or worke-man; If this enſuing ſmall Tract of mine upon the Arithmeticall Rods, through the rudeneſſe of the method, ſeeme to you (as well it may) any wayes harſh and unpleaſant, let me crave but only your favourable cenſure, and that is all I deſire; you I know will judge like your ſelves, and approve of any thing that may profit others, though it pleaſure not your owne ſelves; and of you, had I rather be deſervedly controuled,

then to be by others ignorantly commended.

When this following Tract of the use of the Rods was first penned, about nine or ten yeares agone, there was then, nor long since, no thoughts of ever its coming to publique sight, but the earnest desires of some, of better abilities then my selfe, have as it were forced me to set it on the Stage; If any shall despise it, by reason of my meannesse and want of eloquence, for indeed it is not set forth with any eloquence of words and method, but in plaine and rude high-way termes; let me tell them, that the Mathematick *Arts are in themselves of such excellencie, that they scorne to receive any grace or lustre from the flourishing tongues and pens of any the most eloquent Orators; and the Studious in those Arts are seldome found in eloquence. The method I confesse is rude and rustick, like my selfe, but the matter is not so; I am sure here is a good Tree, though it may be not very well hewen; here is a goodly peece of cloth, though the garment may be not so well made as the subject deserveth, yet however, I hope it is not quite mar'd; well, seeing it is*

as

as it is, it cannot be holpen; of the wiſe and learned I crave pardon, and doubt not of obtaining; and for others, whether envious Criticks, or ignorant Momus, *I dare boldly ſay, I intended it not for their hurt, and I am ſure it will do them much good, if they will uſe it. The Dogge in the fable barked at the Moone, but not becauſe it hurt him, but for that he knew not what it was, nor how far it was diſtant from him; I know I ſhall not pleaſe all, neither do I deſire it, for I am not ſo ſimply wiſe as to thinke I can pleaſe all, nor ſo dejected in ſpirit, as to conceive I can pleaſe none. This ſubject pleaſed ſome while it was in private, and why ſhould it not do ſo when it is in publick? I know there be ſome out-ſide-humerous-conceited ones, flouriſhed over with windy words, void of all ſolidity within, having no good opinion of any thing, but what is agreeable to their owne phantaſticall fictions, and that will either for want of love or judgement condemne me, but none of thoſe do I regard, no more then the Moone did that fooliſh Dogge; It is only the impartiall and judicious ſolid judgement*

that I respect, and to which I will submit, from such I am confident I shall receive no hard censure, and to such I commend these my poore indeavours, and whatsoever else I am able in any wayes to performe, and rest servant to all such.

Seth Partridge.

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RABDOLOGIA,

OR

The Art of Numbering by RODS.

CHAPTER I.

Speaking-Rods, their Definition and Fabrick.

RABDOLOGIA, is the Art of counting by Numbring-Rods. As it pleaſed that ever famous Author the Lord *Napier*, the firſt Inventor of that moſt admirable invention of Logarithmes, to call thoſe his excellent tables, by the name of Logarithmes, that is to ſay, ſpeaking-Numbers; Even ſo this of the Rods, *Rabdologia*, that is to ſay, ſpeaking Rods, or the Speech

of Rods. And ſpeaking-Rods they are very properly called; for being ſo Tabulated, that is to ſay, placed, ſet, and layed together, as their nature requireth, they doe of themſelves, tell us, or ſhew forth unto us, with unexpected eaſe and certainty, and without any operation at all, what the product in any Multiplication is, and what the quotient in any Diviſion is, without any charge or trouble of memory, and in Extraction of the Square and Cube root, they doe very much eaſe and expedite the worke.

Theſe ſpeaking-Rods may be made either of Silver, Braſſe, Ivorie, or Wood, as the maker and uſer of them beſt pleaſeth, but they are moſt ordinarily made of good ſollid Box, and being thereof made, they are as uſefull as thoſe made of any other ſubſtance whatſoever, Nay, I hold them more light and nimble then thoſe made of Mettall; They are foureſquare peeces, all planed to a juſt and even thickneſſe, neere about $\frac{1}{5}$ of an Inch ſquare, or ſomething better, and their length is juſt ninetimes their breadth, ſo that they be two inches, or neer thereupon in length. The number of theſe foureſquare Rods, are moſt ordinarily Ten, which are enow for ordinary uſe, you may have 20. 30. or 40. if you will, and as your occaſion ſerveth. To theſe Rods, how many ſoever you have, belongeth a broad peece, of the ſame ſubſtance that the Rods be of, called Lamina, and is of the ſame length and thickneſſe with the Rods, and the breadth

breadth is neere about the breadth of three of the Rods. Theſe Rods being made thus foure-ſquare, have each of them foure faces, ſo that 10. Rods have on them 40. faces, every of which foure faces of every Rod are divided into Nine equall parts, by Nine lines drawne round about the Rod, ſo that upon each face, are Nine perfect ſquares made, & every of thoſe 9. ſquares or parts are divided into two parts, by Diagonall lines, And in thoſe Diviſions, or ſquares, are inſcribed Arithmeticall figures, beginning at the top, or firſt ſquare diviſion, and from thence deſcending downewards to the Ninth Diviſion in an Arithmeticall progreſſion, ſo that they are by this meanes fitted readie for many Arithmeticall works, as Multiplication, Diviſion, and the extraction of Roots, &c. But to avoid many words in deſcribing theſe vocables, behold the ſhape and figure of all thoſe 10. Rods, and the numbers ſet on every of their foure faces. Every practitioner may make them himſelfe by cutting the faces of every one of the printed papers of the Rods, and ſo placed on a ſquare piece of wood as before; or elſe they are ready made in Wood, by Maſter *John Thompſon* in Hoſier lane neere Smithfield, who makes all kinde of Mathematicall Inſtruments, and alſo by Mr. *Anthony Thompſon* in Greſham Colledge, and by Mr. *Thomas Browne* at the Globe neere Aldgate. In Silver or Braſſe they are made by Mr. *Elias Allen*, over againſt St. Cle-

menrs Church without Temple-Barre.

But note by the way, that though I have inſcribed upon the Rods the ſame numbers that were uſed at the firſt invention, yet I have not inſcribed them altogether in the ſame manner; for there the inſcriptions upon the third and fourth faces were ſet on inverſe unto thoſe numbers on the firſt and ſecond faces: and this way of inſcription I finde to be the beſt, becauſe it ſaveth the labour of turning the Rods end for end, which of neceſſity muſt be done when the numbers are ſet on them inverſe, according to that other way.

In this deſcription of the Rods, you may ſee the figures of each face of the Rod doe begin at the top, or upper ſquare ſpace next to the end, and deſcend downe in an Arithmeticall progreſſion; as on the ſecond face of the firſt Rod the figures begin at the top with an unite, thus, 1. on the right of the Diagonall line, and deſcend downward in an Arithmeticall progreſſion, thus, 1. 2. 3. 4. 5. 6. 7. 8. 9. every figure downewards encreaſing by one unite; on the third face of the ſame Rod, the upper figure is 9. and the reſt of the figures deſcending downwards, being 18. 27. 36. 45. 54. 63. 72. 81. each ſquare exceeding his next by 9. And on the fourth face the figures are 8. 16. 24. 32. 40. 48. 56. 64. 72. every number equally exceeding or increaſing his former by 8. but upon the firſt face of the ſame firſt Rod are only cyphers,

cyphers, as there are alſo upon one of the faces of the ſecond, third, and fourth Rods. Upon one face of the ſecond Rod the figures begin with 2. at the top or upper diviſion, and doe deſcend downewards in the like Arithmeticall progreſſion, in this manner, 2.4.6. 8. 10. 12. 14. 16. 18. each one equally exceeding, and encreaſing his former by 2. upon one other of the faces of the ſame ſecond Rod the figures are 9. 18. 27. 36. 45. 54. 63. 72. 81. And upon the other face the numbers be 7. 14. 21. 28. 35. 42. 49. 56. 63. And the ſecond face of the third Rod beginneth at the top, or uppermoſt ſquare diviſion, with 3. and endeth below with 27. each number in an Arithmeticall progreſſion, equally exceeding, or encreaſing, his former by 3. as thus, 3. 6. 9. 12. 15. 18. 21. 24 27. the like of any other; ſo that whatſoever the firſt figure of any one Rod, or the firſt figures of many Rods laid together ſhall be, the ſecond figure in the next (or ſecond) ſquare ſpace of the ſame Rod, or the ſecond figures in the ſecond ſquare ſpaces, or lines of ſquares of many Rods laid together, ſhall be double to the firſt, in the third line triple, in the fourth quadruble, and ſo on to the ninth, which is noncuple to the firſt. Thus the firſt figure of the ſecond face of the ſecond Rod being 2. the ſecond figure in the ſecond ſquare of that Rod is 4. And in the third ſquare the figure is triple to the firſt, as 6. is the triple of 2. In the fourth

ſquare, quadruple to the firſt, as 8. is the quadruple of 2. In the fifth ſquare, quintuple to the firſt, as 10. is quintuple to 2. And the figures in the ſixt ſquare are ſextuple to the firſt, as 12. is the ſextuple of 2. In the ſeventh ſquare the figures are ſeptuple to the firſt, as 14. is the ſeptuble of 2. In the eight line or ſquare, the figures are octuple to the firſt, and ſo 16. is the octuple of 2. And laſtly, in the ninth and loweſt ſquare, the figures there be noncuple to the firſt, as 18. is the noncuple of 2. The ſame is to be obſerved in many Rods laid together. Conſider but well upon the Rods, and they will inſtruct you better then many words.

Obſerve that when there is but only one figure in a ſquare, it is alwayes ſet on the right hand of the Diagonall line, as are all the figures on the ſecond face of the firſt Rod. and ſo are all the top figures of all the faces of the Rods, and be only ſingle Digits, and the figures on the left hand of the Diagonall lines are Article Numbers.

There is alſo to theſe Rods a frame to be made, to Tabulate or lay the Rods in when you worke with them, (you may uſe them without if you pleaſe, but to worke with them in a frame is farre the better way, and is alwayes intended to be uſed with them through all this following diſcourſe,) This frame is but only a ſmall thin board, as large for length, as is the length of the Rods, and as wide as the breadth

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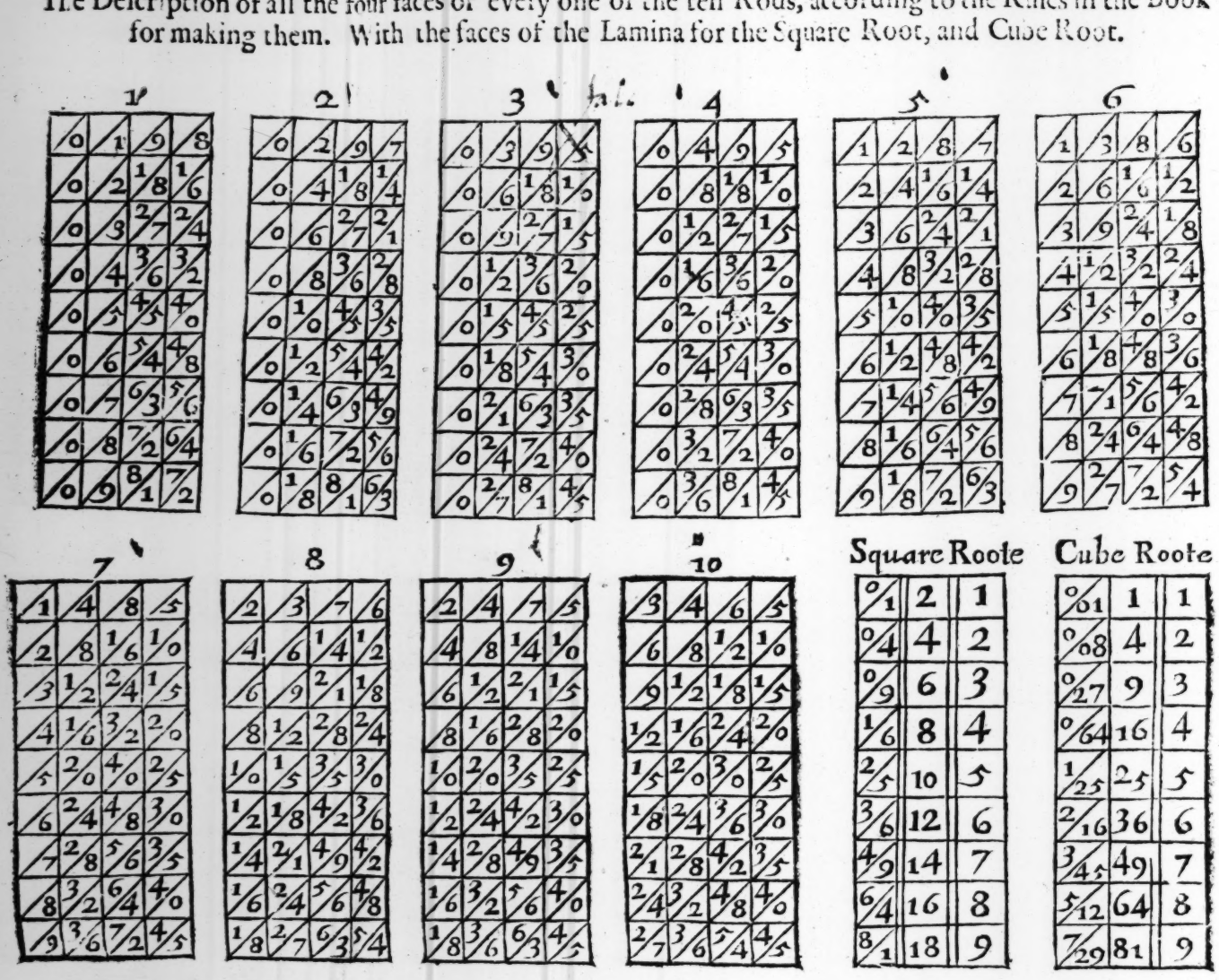
The Description of all the four faces of every one of the ten Rods, according to the Rules in the Book for making them. With the faces of the Lamina for the Square Root, and Cube Root.



These Rods being Printed on a clean paper, may be cut out into so many severall slips, and pasted on little four square pieces of wood, or on little slips of fine Past-board, or on little slips of good thick Vellome, and so will save the cost, or labour of making them: Or any man may make them according to the Rules prescribed in the Book or may buy them ready made in Brasse of Mr *Elias Allen* in the *Strand*; and in wood, of Mr. *John Thompson* in *Hosier-Lane*, or of Mr. *Anthony Thompson*, or of Mr. *John Browne* at the *Globe* neere *Aldgate*.

Place this Table at the end of the first Chapter, Folio 7.

of all the 10. Rods, with the Lamina, layed all cloſe together ſide by ſide, but if you have a greater number of Rods then 10. it is requiſite the frame ſhould be the larger, that ſo you may Tabulate more then 10. places of figures in one number; this board is to have two ledges upon it of equall thickneſſe to the Rods, ſet on ſquare-wiſe, the one at the top, and the other at the left ſide, and that ledge on the left ſide is to be divided into nine equall ſquare parts as the Rods are, and figures ſet on them, beginning at the head or top ſquare, and deſcending downwards, thus, 1. 2. 3. 4. 5. 6. 7. 8. 9. like to the ſecond face of the firſt Rod. It is farre better to Tabulate the Rods in a frame, or Table thus made, then without, for the frame keeps them even at the head, and to lie ſquare and cloſe together, and the numbers on the ledge doe very readily guide you to the product, in any Multiplication, and to the figure for the quotient, in any Diviſion. Thus much of the fabrick of this Vocall Arithmeticall Inſtrument, now next of Numeration thereupon. Of the Lamina above mentioned we ſhall ſpeak when we come to the Extraction of Roots whereunto it only ſerveth.

CHAP. II.

Of Numeration by the Rods, ſhewing how to Tabulate them, or any number upon them.

TO number upon the Rods, or to Tabulate the Rods, is ſo, and in ſuch manner to lay or frame them, or ſo many of them together, as may ſuffice to expreſſe and ſet forth any Number given, or conceived in minde, which to effect, take ſo many Rods as your number given hath places of figures in it, and them Rods ſuch as have in their top ſquares, or upper columes, the figures of the Number given, and lay them downe in your frame cloſe together ſide by ſide, laying that Rod higheſt towards the ledge on the left hand, that in his top or upper ſquare ſpace hath the figure of the higheſt place in that number given towards the left hand, and next to that, the Rod that carrieth in his top ſquare the ſecond figure of the Number given, and ſo every one in order, how many places of figures ſoever the number hath.

For Example, let this number 1615. be a number given to be ſet forth upon the Rods, for performance whereof, take theſe foure Rods that have theſe foure numbers in their top or upper ſquares, and firſt take a Rod that hath for his top or firſt figure this figure 1. the reſt of the figures on the ſame face being 2. 3. 4. 5. &c. to 9. this Rod lay downe firſt (with that face upwards,)

upwards,) next to the ledge on the left hand; Then take forth for the ſecond Rod, one ſuch a Rod as hath on his top ſquare the figure 6. the reſt of the figures of that face being 12. 18. 24. &c. to 54. below, this Rod place in the ſecond place cloſe by the firſt Rod, and on the right hand thereof, and then the number repreſented by the two figures, in the tops of theſe two Rods, is 16. being equall, and the ſame with the two firſt figures of the number given; Then next take for the third Rod, ſuch a one againe as carrieth in his upper ſquare this unite 1. and place it downe cloſe, and next to the other two, and then the number repreſented by the upper faces of theſe three Rods is 161. the three firſt figures of the number given; Laſtly, for the fourth and laſt figure of the number given which is 5. take forth ſuch a Rod that carrieth in his upper ſquare the figure 5. and lay it downe next to the other three, and cloſe to them, and then the number given, 1615. is Tabulated and ſet forth upon theſe foure Rods, on their upper line of ſquares. After this manner any other number may be Tabulated, and ſet forth upon the Rods. I will ſhew one Example or two more, the better to explane the Rule, and ſhew the variety of works.

Let this number 32794. be a number given to be Tabulated upon the Rods. To performe which I take five Rods that have on their top ſquares the five figures given, 3. 2. 7. 9. and 4.

and firſt I take that Rod which in his top ſquare carrieth the figure 3. and that Rod I place in the Table or frame, next the ledge on the left hand; Then take a Rod that carrieth on his top the figure 2. and lay it downe in the frame cloſe by the former, and then the number repreſented, and ſet forth upon theſe two Rods in their upper ſquares, is 32. anſwerable to the two figures in the two upper places of the number given; Next take forth a third Rod, who carrieth on his top the figure 7. and lay it downe in the frame next unto, and cloſe by the other two, and then the figures on the top Diviſions of theſe three Rods, doe anſwer 327. the three firſt and higheſt figures of the number given; Now for the fourth figure of the number given, which is 9. take forth one ſuch a Rod as hath in his top ſquare the figure 9. and lay it downe in the frame cloſe to the other three, and then the foure figures on the upper ſquares of theſe foure Rods, ſet forth 3279. the foure firſt figures of the number given; Laſtly, take forth for the fift and laſt Rod, one ſuch a Rod as hath in his upper ſquare the laſt figure of the number given, that is 4. and this Rod place downe in the frame, as you did the other before, cloſe to the ſide of the other foure Rods, and then you may behold the number given, 32794. to be repreſented and ſet forth to your eye, upon the top line of ſquares of theſe five Rods, ſo is the number given, Tabulated, as was required.

Example

Example 3. Let it be required to Tabulate this great number 4405066691. conſiſting of 10. places of figures; To doe which, as afore in the former examples, firſt, take two Rods who have in their upper Diviſions the figures 4. and 4. and place them in the frame cloſe together, ſide by ſide, next to the ledge on the left hand, and they doe ſhew forth 44. then next take one ſuch a rod, who carrieth upon one of his faces only cyphers, and place it with that face upward next the other two, ſo you have 440. the three figures in the three higheſt places of the number given; Then place a Rod next to that, carrying the figure 5. and next to that one of the Rods carrying only cyphers, and then have you 44050. ſet forth to your eye upon theſe five Rods, which are anſwerable to the 5. higheſt figures of the number given. Now the next three figures being ſixes, take forth three Rods, who on their top ſquares carrie the figures 6. and place them three Rods cloſe next to the other five, and then you have laid forth to your view 44050666. the eight higheſt figures of the number given; and now you want but only two figures of the number given to Tabulate, which be 9. and 1. therefore take two Rods, one carrying 9. in his top ſquare, and place it downe next to the other eight, and laſtly, the Rod that carrieth the figure 1. in his upper part, place loweſt and laſt, as being the laſt and loweſt figure of that propoſed number;

this

this being done, the work is ended, for as much as the number 4405066691. is Tabulated, which was required to be done, and is plainly repreſented, and ſet forth on theſe 10. Rods, upon their upper line of ſquares, and the number in words is thus to be read or propounded, foure thouſand foure hundred and five Millions, ſixty ſix thouſand ſix hundred ninety one. Theſe three examples I hope are ſufficient, to teach the manner how to Tabulate any number upon the Rods.

Note, that if you have but 10. Rods, then you can Tabulate but only foure figures of one and the ſame ſpecies, quantity or value, in one and the ſame number, as foure Cyphers, thus, 0000 Or foure Units, thus, 1111. Or foure figures of two, thus, 2222. or foure figures of three, thus, 3333. Or foure figures of nine, thus, 9999. But if you have twenty Rods, you may Tabulate in one number eight places of figures, of one and the ſame ſpecies or quantity, as eight places of Cyphers, thus, 00000000. Or eight units, thus, 11111111. Or eight figures of two, thus, 22222222. Or eight figures of eight, thus, 88888888. And if you have 30. Rods, you may Tabulate 12. places of figures of one and the ſame quantity: And if 40. Rods, then 16. figures of one and the ſame ſpecies, &c. I would wiſh every man that intends to make much uſe of this excellent Arithmeticall Inſtrument, to have two Sets of Rods, that is to ſay, 20. Rods,

for

for he may have at ſome time or other occaſion to Tabulate five, ſix, or ſeven figures, of one and the ſame quantity, in one number given. I my ſelfe working upon the Rods ſome concluſions, by the tables of Sines and Tangents, happened upon the Tangent of 41. Degrees. 38. minutes, which I was to Tabulate, this Tangent, although it conſiſt but of ſeven places, yet 5. of the figures are all of one quantity, which Tangent is this number, 8888826. So that unleſſe I had had two ſets of Rods, that is, 20. I ſhould have been diſappointed of any help by the Rods, in working the worke then in hand. An other time working by the ſame Tables, it happened, I muſt Tabulate the Sine of 51. Degrees. 4. minuts, the Sine whereof is 7778777. Conſiſting of ſeven places of figures, and ſix of them all of one and the ſame ſpecies; ſo that I finde, that though 10. Rods may well ſuffice any mans moſt ordinary uſe, yet it often happeneth, that a greater number may be requiſite, and ſo I would adviſe every man to have: the great eaſe and help he ſhall finde in working by the Rods, will abundantly exceed the ſmall charge of buying them.

CHAP. III.

To reade and expreſſe any numbers upon the Tabulated Rods.

BY the former Chapter you underſtand, that the Rods being Tabulated to any number given, or elſe Tabulated at an adventure, that number on the Rods, in their upper line of ſquares (next the ledge, at the head of the frame) is ſaid to be, and indeed is, the number Tabulated, and is the prime, or ſimple number it ſelfe, and how it is to be read, and expreſſed in words or writing, is there ſufficiently ſhewed. But to read, or expreſſe any number in any other line of ſquares below the firſt, Obſerve theſe Rules; Firſt, that in the ſecond ranck, or line of ſquares, the figures there are double to the figures in the firſt line; In the third line of ſquares the figures therein inſcribed are Triple to thoſe in the firſt line; and in the fourth line of ſquares, the numbers are Quadruple to the firſt; In the fift, Quintuple to the firſt; In the ſixt line Sextuple; In the ſeventh, Septuple; In the eighth line, Octuple; and in the Ninth & loweſt, Noncuple to the firſt. And ſecondly note, that when the Rods are Tabulated, the Diagonall lines of every two Rods lying next and cloſe together, doe make perfect Romboydes, in which Romboydes, many times, are two digits or ſingle figures comprehended, one on the right hand

hand corner of the Romboydes, and the other on the left hand corner, which two figures, in reading or expreſſing the number in that line of ſquares, muſt be added together, and the ſumme of them both be pronounced as one figure, and if the two figures ſo added together amount to 10. then account that Romboydes as a Cypher, and adde or account 1. for the ten to the ſumme of the figures in the next higher Romboydes towards the left hand, but if the two figures in any Romboydes doe make above 10. then the overplus above 10. is to be read, and pronounced in that Romboydes, and 1. for 10. muſt be added, and pronounced with the numbers in the next higher Romboydes.

To illuſtrate this by examples, and firſt the Rods being Tabulated, (as they were in the firſt example of the former Chapter) to the number 1615. there the numbers in the ſecond rancke or line of ſquares is Duple to that firſt, and the figures in the higheſt Romboydes next the left hand, made by the Diagonall lines of the two firſt Rods, are 2. and 1. that is, 2. on the firſt Rod next the left hand ledge, and 1. on the other halfe of that Romboydes on the ſecond Rod, which both make 3. and ſo muſt be read and pronounced. In the ſecond Romboydes is only one figure, *viz.* 2. comprehended in the firſt halfe of that ſecond Romboydes, And then the figures contained in the third Romboydes made between the third and fourth Rods, are 2.

and

and 1. that is 2. in that halfe of the Romboydes which is upon the third Rod, and 1. in the other halfe of that ſame Romboydes, which is on the fourth Rod, which two figures muſt likewiſe be read 3. And laſtly, in the outmoſt and loweſt halfe of the Romboydes, which is upon the fourth Rod, is contained a Cypher; Now therefore the numbering figures of that ſecond rancke, or line, are thus to be expreſſed in writing, 3230. and read three thouſand two hundred and thirty. Againe, the third line of numbers being triple to the firſt, you ſhall finde in the higheſt Romboydes 3. and 1. that is 4. in the ſecond Romboydes only 8. and in the third againe 3. and 1. that is 4. and in the laſt and loweſt halfe Romboydes is 5. and ſo the figures in that third ranke are thus to be expreſſed in writing 4845. and read foure thouſand eight hundred fourty five. Then the figures in the fourth line of ſquares being quadruple to the firſt, are 4. and 2. in the firſt Romboydes, that is 6. 4. in the ſecond, and 4. and 2. in the third, which make 6. and in the laſt halfe Romboydes 0. therefore the number in that line is thus to be expreſſed 6460. The fift line of ſquares carrieth the Quintuple of the firſt, in which line the figures are in the firſt Romboydes 5. and 3. that is 8. in the next 0. in the third 5. and 2. that is 7. and laſtly 5. all which are thus to be ſet forth in writing 8075. Next the ſixt line of numbers being ſextuple to the

the firſt, doth carrie this number 9690.

The ſeventh line of ſquares (or you may, if you will, call it the line of Roymboydes) is Septuple to the firſt line, in which line the loweſt figure is 5. in the halfe Romboydes, then 7. and 3. is 10. in the firſt whole Romboydes, therefore that Romboydes is to be accompted as a 0. and 1. is to be accounted or added to the figures in the next higher Roymboydes, which is there 2. making it 3. and ſo is to be read; then in the next higher Romboydes is 7. and 4. which is 11. here 1. the overplus above 10. is to be read and accounted in that Romboydes only, and 1. for 10. muſt be accounted one place higher, but becauſe there is no number there, to which it muſt be added, therefore it muſt be accounted or ſtand alone, and the number repreſented upon that ſeventh line is 11305. which is the Septuple of 1615. the firſt number. By this you may ſee that we can take, or expreſſe the numbers upon Rods, either forwards or backwards, and every man may uſe that way he beſt liketh. Again, the eighth line of Romboydes, carrieth forth this number 12920. which is the Octuple of the firſt. Laſtly, in the ninth line of ſquares or Romboydes, you have in the higheſt Romboydes next the left hand 9. and 5. which make 14. therefore 4. is be read in that Romboydes, and 1. for the 10. in one place higher, then 4. in the next Romboydes muſt be read 5. becauſe 9. and 5. in the loweſt Romboydes make 13.

and

and therefore 1. for 10. is to be carried one place higher, which is to this ſingle 4. making it 5 and in that next Romboydes, is to be read 3. and finally 5. in the loweſt halfe Romboydes, which Number in that ninth line is thus to be read and expreſſed, 14535. and is the Noncuple of 1615. in the firſt line Tabulated. This one Example well obſerved might ſuffice for inſtruction in this particular, but yet to ſhew the more variety of works, I will adde one or two more for this Chapter being well underſtood, will be much eaſe, and help to the underſtanding of that which followeth.

Example 2. Let the number 32794. be the number given, and Tabulated upon the Rods as was afore in the ſecond Example of the former Chapter, and then look but upon the ſecond ranke, or line of numbers, and at firſt you ſhall have preſented to your eye 6. in the firſt Romboydes. 4. and 1. in the next, and again 4. and 1. in the third Romboydes, next 8. and laſtly in the halfe Romboydes 8. ſo that the number found in that ſecond ranke, is 65588 which is the Duple of 32794. in the firſt ranke. The third ranke of Romboydes giveth for the Triple of the firſt number 98382. In the fourth line of ſquares, the number there to be collected is 131176. the Quadruple of 32794 for in the firſt and higheſt halfe Romboydes is only 1. 2. in the firſt whole Romboydes, with 1 that ariſeth over in the ſecond is 3. for aſmuch

wo figures therein contained with one
at ariſeth from the next Romboydes is
hat in the ſecond and third whole Rom-
is to be read but only 1. The number in
line is 163970. being the Quintuple of
. And the Sextuple is 196764. The ſep-
229558. for 9. and 6. in the third Rom-
is 15. giving 5. to be read in the ſame
oydes, and 1. to be added to the two
es in the ſecond Romboydes, making them
Againe, the Octuple of 32794. is 262352.
you have in the loweſt halfe Romboydes 2.
he loweſt whole Romboydes 3. and 2. is 5.
the next Romboydes 7. and 6. is 13. giving
for that Romboydes, and 1. to be added to
next above, making the 6. and 5. there, to
12. therefore 2. is to be underſtood to be in
t place, and 1. is to be added to the 4. and
1 the higheſt Romboydes, then followeth
1 the higheſt halfe Romboydes, ſo is the
ber 262352. gathered together. Laſtly,
Noncuple of 32794. is 295146. the number
ied upon the ninth line of ſquares. All rea-
given into your hand, without any trouble
memory, as is, and muſt be, in ordinary
ltiplication.

Again, in the third Example of Tabulating
Rods, to that number of 10. places, re-
d in the foregoing Chapter, namely,
0506691. where 10. Rods are in uſe; Now
in the ſecond line of ſquares, the Duple thereof
is,

and therefore 1. for 10. is to be carr
place higher, which is to this single 4. mak
and in that next Romboydes, is to be rea
finally 5. in the lowest halfe Romboydes
Number in that ninth line is thus to
and expressed, 14535. and is the None
1615. in the first line Tabulated. This
ample well observed might suffice for i
on in this particular, but yet to shew th
variety of works, I will adde one or two
for this Chapter being well understood, wi
much ease, and help to the understandin
that which followeth.

Example 2. Let the number 32794.
number given, and Tabulated upon the R
as was afore in the second Example of the
mer Chapter, and then look but upon the
cond ranke, or line of numbers, and at first
shall have presented to your eye 6. in the
Romboydes. 4. and 1. in the next, and a
4. and 1. in the third Romboydes, next 8
lastly in the halfe Romboydes 8. so tha
number found in that second ranke, is 65
which is the Duple of 32794. in the first r
The third ranke of Romboydes giveth fo
Triple of the first number 98382. In the fc
line of squares, the number there to be c
cted is 131176. the Quadruple of 32794
in the first and highest halfe Romboydes is
1. 2. in the first whole Romboydes, wi
that ariseth over in the second is 3. for asm

as the two figures therein contained with one unite that ariſeth from the next Romboydes is 11. ſo that in the ſecond and third whole Romboydes is to be read but only 1. The number in the fift line is 163970. being the Quintuple of the firſt. And the Sextuple is 196764. The ſeptuple is 229558. for 9. and 6. in the third Romboydes is 15. giving 5. to be read in the ſame Romboydes, and 1. to be added to the two foures in the ſecond Romboydes, making them 9. Againe, the Octuple of 32794. is 262352. for you have in the loweſt halfe Romboydes 2. in the loweſt whole Romboydes 3. and 2. is 5. In the next Romboydes 7. and 6. is 13. giving 3. for that Romboydes, and 1. to be added to the next above, making the 6. and 5. there, to be 12. therefore 2. is to be underſtood to be in that place, and 1. is to be added to the 4. and 1. in the higheſt Romboydes, then followeth 2. in the higheſt halfe Romboydes, ſo is the number 262352. gathered together. Laſtly, the Noncuple of 32794. is 295146. the number carried upon the ninth line of ſquares. All readily given into your hand, without any trouble of memory, as is, and muſt be, in ordinary Multiplication.

Again, in the third Example of Tabulating the Rods, to that number of 10. places, recited in the foregoing Chapter, namely, 4405066691. where 10. Rods are in uſe; Now in the ſecond line of ſquares, the Duple thereof

is,

is set forth to be 8810133382. The Triple of the ſame Tabulated number is 1321520007[illegible] The fourth line giveth the Quadruple 17620266764. The Quintuple in the fift line appeareth to be 22025333455. And the ſixt line rendereth the Sextuple, 26430400146. In the ſeveventh line you ſhall finde your Septuple 30835466837. The eighth line produceth for the Octuple 35240533528. Laſtly, the ninth and loweſt line of ſquares ſetteth forth this number 39645600219. which is Noncuple to the firſt, and this number of 11. places is thus to be read, Thirty nine thouſand ſix hundred fourty five millions, ſix hundred thouſand two hundred and nineteen.

Thus much without doubt is enough of this Subject: If I have been too tedious, pardon me for it is only my deſire to make the uſe of the Rods cleer to the underſtanding of every well affected man, that moveth me to the work Now I will proceed to the uſe of this worthy Inſtrument, in the Rules of Multiplication, Diviſion, The Rule of Three, The Extraction of Roots, Square and Cubick, in all which, and many Rules more, the great facility of working by the Rods doth plainly appeare, And for an eaſier way to worke Addition and Subtraction, then is taught in ordinary Arithmetick, cannot by any man, or by any meanes be preſcribed, therefore they ſhall be paſſed over in ſilence, for I intend not to write a Trea-

tiſe

tiſe of Arithmetick, but to ſet forth the uſe of this Arithmeticall Inſtrument, an Inſtrument indeed, but ſimple in the outward appearance, yet excellent in the certainty and facility of its uſe.

CHAP. IIII.

Of Multiplication by the Rods.

MUltiplication of Numbers, is a Rule of Arithmetick by which we multiply two Numbers together, the one by the other, to the end that a third Number, being their product, may be diſcovered. So that in Multiplication two Numbers are given, the Multiplicand, & Multiplicator; the Multiplicand is the Number given to be multiplied, the Multiplicator is the Number given, by which the Multiplicand is to be multiplied, and the third Number ſought for, is called the Product, which doth ſo many times containe the Multiplicand, as there be units in the Multiplicator.

Multiplication is a more brief and eaſie working of many Additions, (but working by the Rods is moſt brief and eaſie, as will appeare anon,) For if we multiply 140. by 44. the Product is 6160. ſo likewiſe if wee ſet downe 140. 44. times together, or 44. 140. times together, the Addition of all theſe numbers together will amount to 6160. as before: But this way

way of working by Addition were a very difficult and tedious worke, indeed worke enough to overcharge the memorie of a very good Artiſt, And therefore this Rule of Multiplication was deviſed, by which at one only working, without ſo great charge of the memory, queſtions of this nature are readily anſwered; But yet by our Rods any two numbers may be multiplyed together with farre greater eaſe, ſpeed, and certainty, then by that Ordinary way, without any charge at all to the Memory.

Multiplication is either ſingle or compound.

Single Multiplication is, when the Multiplicator conſiſteth but of one ſingle figure only, though the multiplicand conſiſt of many.

Compound Multiplication is, when the numbers to be multiplyed together, that is to ſay, the Multiplicand and the Multiplicator, conſiſt both of them, of more places of figures then one.

For ſingle Multiplication by the Rods, you are firſt to Tabulate the Multiplicand, and then look upon the left hand ledge of the frame for the figure of your Multiplicator, againſt which figure, you have in the line of ſquares upon the Rods the product ſought for. Example, if you are to multiply 672. by 4. Tabulate three Rods that have on their top ſquares the three figures 6. 7. and 2. the three figures of the number given, in order as they ought; firſt, place the Rod with the figure 6. next the ledge, and the

7. next,

7. next, and the Rod with the figure 2. laſt. Which being done, look upon the ledge for the figure 4. againſt which upon the fourth line of ſquares, on the Rods, you ſhall ſee in the firſt halfe Romboydes 2. and in the firſt whole Romboydes 4. and 2. that is 6. In the ſecond Romboydes 8. And laſtly, in the laſt and outmoſt halfe Romboydes 8. ſo that by the Rule of the third Chapter, you muſt ſet downe the ſumme of that ranke, or line of numbers, thus, 2688. which is the true product of 672. multiplyed by 4. which was demanded. Againe, if it be demanded to give the product of the ſame 672. being multiplyed by 6. the Rods being Tabulated as before, doe but only look the figure 6. upon the ledge, and right againſt it on the Rods, you ſhall read this number 4032. which is the product of 672. multiplyed by 6. which was demanded. If it be againe demanded what the product is of the ſame 672. multiplyed by 8. look but upon the Rods againſt the figure 8. on the ledge, and the Rods readily ſhew you the product thereof to be 7595. the thing required.

Againe, for Example, Let it be required of you to ſhew what, or how much 6. times 7595. is. To anſwer which queſtion, Tabulate upon the Rods the number 7595. by the rules of the ſecond Chapter, which being done, look but upon the Rods in the line of ſquares, againſt 6. on the ledge, and there you ſhall read this number

ber 45570. which is the ſumme of 6. time 7595. the number given. And further, if you b required to declare what ſeven times 7595. a mounteth unto, look upon the Rods in the lin againſt the figure 7. on the ledge, and there ſhal you have theſe figures, firſt 4. then 9. and 3 then 5. and 6. and then 3. and 3. and laſtly 5 which figures by the rules of the former Chap ter are thus to be read and expreſſed in writing 53165. that is to ſay in words at lenghth, fift three thouſand one hundred ſixty five, and the true product of 7595. multiplyed by 7. is that demand truly, preſently, and eaſily an ſwered.

In compound Multiplication, where both th Multiplicand and Multiplicator conſiſt of man places of figures, you muſt evermore Tabulat the Number that you will make the Multipli cand, and then your Multiplicator (you may you will) write downe in a paper, and draw line under it. Theſe figures of the Multiplica tor, you muſt look out ſeverally upon the ledg of the frame, and againſt every figure of th Multiplicator, you ſhall finde the ſeverall pro ducts of the Multiplicand being multiplyed b thoſe figures, which muſt be taken from off th Rods, and ſet down in writing in the paper under the Multiplicator, beginning firſt (if yo will) with the higheſt figure of the Multiplica tor next to the left hand, and ſet the produc thereof down firſt; Then take the product o th

the ſecond figure from off the Rods, and ſet it down on the paper, under the product of the other figure afore ſet downe, but one place lower towards the right hand; Or you may begin firſt with the loweſt figure of the Multiplicator, next to the right hand, (according as you doe in ordinary Multiplication by the pen) ſetting down the product thereof firſt; and then take the product of the ſecond figure, and ſet that downe under the other, one place higher towards the left hand, and ſo proceed on, from figure to figure, how many ſoever you have in your Multiplicator. Some few Examples will make all plaine.

Firſt, let this queſtion be propounded, How many dayes are there in 1615. yeares; You know, that in one common year, according to the ordinary account, are 365. dayes; with the odde houres and minutes above, which in every foure years make near one day, we meddle not; Therefore to know, and ſo to anſwer the queſtion, how many dayes are in 1615. years, you muſt multiply 1615. and 365. the one by the other, which to doe, you muſt firſt Tabulate one of the numbers given, as the number 1615. the other as 365. write down in a paper, and alſo look upon the ledge, and finde there alſo the three figures, 3. 6. and 5. and firſt, look on the Rods along in that line of ſquares, againſt 3. on the ledge, and you ſhall ſee the number there given, to be 4845. which take, and ſet

downe in a paper, below the line under the Multiplicator, as here in the example annexed doth appeare. Secondly, look upon the Rods, along in that line of ſquares, againſt 6. the ſecond figure of the Multiplicator, and there ſhall you have ſet forth unto you, the number 9690. which you muſt take from off the Rods, and ſet it down under the former 4845. one place lower towards the right hand, and firſt ſet the Cypher a place below the 5. in that line above, then ſet the 9. your ſecond figure under that 5. and your 6. under that 4. and laſtly, 9. your higheſt figure ſet down under the 8 above, and ſo you have done with that number, as in the Example you ſee it ſtand. Then for 5. the laſt figure of the Multiplicator, look it upon the ledge, and right againſt it, on the line of ſquares, upon the Rods, is ſet forth this number 8075. which you muſt take from off the Rods, and ſet it down under the other two numbers already ſet downe, but one place lower towards the right hand, as the 5. ſet it one place lower then the Cypher, the 7. ſet under the Cypher, and your Cypher ſet under the 9. and laſtly ſet 8. the higheſt figure, under the 6. and 4. in the numbers above; Now having gathered together all the ſeverall products of the Multiplicand, 1615. multiplyed by

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1615
 365
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4845
 9690
  8075
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589475
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by 365. and ſet them downe in their due place and order, You are next to adde theſe three numbers together, by the Rules of ordinary Addition, beginning at the right hand; firſt ſetting downe the 5. then 7. and 0. is 7. then next 9. and 5. is 14. ſet downe 4. and beare 1. to the next place, and then there ſay, 1. I beare, and 8. is 9. and 6. is 15. and 4. is 19. ſet down the 9. and beare 1. then ſay, 1. I beare, and 9. is 10. and 8. is 18. ſet down 8. and bear 1. then ſay, 1. I bear, and 4. is 5. this 5. ſet down laſt and higheſt, and the worke is done, and the totall of three numbers added together, is 589475. which is the number of dayes in 1615 yeares, the thing demanded.

If you will, you may worke according to the Rules for the pen, beginning firſt with the figure 5. and take the product of 1615. by it, which as afore is, 8075. and ſet that down firſt, as in this other example, then take of the product of 1615. multiplied by 6. which upon the Rods againſt 6. you ſhall ſee is, 9690. this ſet down under the former, 8075. but one place higher towards the left hand, that is to ſay, ſet the Cypher under 7. the figure 9. under nothing, the figure 6. under 8. and then ſet 9. the uppermoſt figure a place higher, as in the Example anexed you may ſee; Then proceed to the

downe in a paper, below the line under the Multiplicator, as here in the example annexed doth appeare. Secondly, look upon the Rods, along in that line of ſquares, againſt 6. the ſecond figure of the Multiplicator, and there ſhall you have ſet forth unto you, the number 9690. which you muſt take from off the Rods, and ſet it down under the former 4845. one place lower towards the right hand, and firſt ſet the Cypher a place below the 5. in that line above, then ſet the 9. your ſecond figure under that 5. and your 6. under that 4. and laſtly, 9. your higheſt figure ſet down under the 8 above, and ſo you have done with that number, as in the Example you ſee it ſtand. Then for 5. the laſt figure of the Multiplicator, look it upon the ledge, and right againſt it, on the line of ſquares, upon the Rods, is ſet forth this number 8075. which you muſt take from off the Rods, and ſet it down under the other two numbers already ſet downe, but one place lower towards the right hand, as the 5. ſet it one place lower then the Cypher, the 7. ſet under the Cypher, and your Cypher ſet under the 9. and laſtly ſet 8. the higheſt figure, under the 6. and 4. in the numbers above; Now having gathered together all the ſeverall products of the Multiplicand, 1615. multiplyed by

1615
365
4845
9690
8075
589475

by 365. and ſet them downe in their due place and order, You are next to adde theſe three numbers together, by the Rules of ordinary Addition, beginning at the right hand; firſt ſetting downe the 5. then 7. and 0. is 7. then next 9. and 5. is 14. ſet downe 4. and beare 1. to the next place, and then there ſay, 1. I beare, and 8. is 9. and 6. is 15. and 4. is 19. ſet down the 9. and beare 1. then ſay, 1. I beare, and 9. is 10. and 8. is 18. ſet down 8. and bear 1. then ſay, 1. I bear, and 4. is 5. this 5. ſet down laſt and higheſt, and the worke is done, and the totall of three numbers added together, is 589475. which is the number of dayes in 1615 yeares, the thing demanded.

If you will, you may worke according to the Rules for the pen, beginning firſt with the figure 5. and take the product of 1615. by it, which as afore is, 8075. and ſet that down firſt, as in this other example, then take of the product of 1615. multiplied by 6. which upon the Rods againſt 6. you ſhall ſee is, 9690. this ſet down under the former, 8075. but one place higher towards the left hand, that is to ſay, ſet the Cypher under 7. the figure 9. under nothing, the figure 6. under 8. and then ſet 9. the uppermoſt figure a place higher, as in the Example anexed you may ſee; Then proceed to the

highest figure of the Multiplicator, which is 3. looking on the Rods against 3. on the ledge, and behold, you shall have represented to your eye, the number 4845. which, set down under the other two numbers, but one place higher towards the left hand, that is, set the lowest figure now new found, which is 5. under the figure 9. and 0. in the lines above, and then all the rest in due order, as you may see it done in the Example. Then draw a line under those three numbers, and then adde them all together, and the product is 589475. as before. By this you may perceive, that this our Vocall Instrument Arithmeticall can follow the pen according to its ordinary way of working, and also contrary to the pen, as in the first rule of this Example: but the pen can in no wise follow the Instrument, in that way of working, used in the first part of this Example; And yet in both these wayes, the Instrument freeth the memory from the charge of carrying of any numbers whatsoever, and giveth the product, not only speedily and easily, but also most exactly, only with but a little heed taking, in transcribing the numbers from off the Rods.

1615
365
8075
9690
4845
589475

Here, as you see, wee Tabulate the greatest number of the two, making it the Multiplicand, and the lesser number the Multiplicator, as is most

moſt ordinarily uſed: But if you will, you may make the leſſer number the Multiplicand, and the greater the Multiplicator, as here for variety of work, we will make 365. the Multiplicand, Tabu'ating it upon the Rods, and then 1615. muſt be the Multiplicator, therefore we muſt looke out the foure products of 365. multiplyed by 1. by 6. by 1. and by 5. according to the rules aforegoing, and ſet them downe in their due order, as here in the Example, where, firſt ſet downe 365. the number againſt 1. on the ledge; Then ſet downe 2190. the number on the ſixt line of ſquares upon the Rods, under the firſt; but one place lower towards the right hand; thirdly, ſet down 365. the ſingle number found againſt 1. or the number Tabulated it ſelfe, and alſo one place yet lower then that above, laſt ſet downe; Laſtly, for the fourth figure of the Multiplicator 5. take 1825. found in the fift line of ſquares, on the Rods, and ſet it down yet one place lower towards the right hand, as in the Example you may ſee, then draw a line under all theſe foure products, and adde them together, and they produce 589475. agreeable to that in the former works, and ſo the one work proveth the other.

	365
	1615
	365
	2190
	365
	1825.
	589475

Another forme of Multiplication.

THere is an other way or forme of Multiplication, that may be uſed upon the Rods, and ſuch a forme it is, as cannot be uſed by the pen, or by any other Inſtrument whatſoever, which I will briefly ſhew by only working of this former Example, and it is thus performed.

Firſt, Tabulate the number given, 1615. then turne the Rods juſt upſide down, laying that face that was underneath upwards; and then in ſteed of the number given, you ſhall have another number Tabulated, which here in this Example will be 8384. in ſtead of the 1615. with this number, 8384. you may worke, and produce the true product, as well as by the number given, 1615. The manner and forme of this work is thus; Take firſt the Triple of 8384. which is, 25152. and write it down under the Multiplicator; then take the ſextuple from off the Rods, and write it down under the other, but one place lower towards the right hand; next take off from the fifth line of ſquares, the Quintuple of the ſame 8384. which is, 41920. and ſet it under the other two, but only one place lower towards the right hand, as you be accuſtomed; Laſtly, under all theſe three numbers,

```
1615
 365
-----
25152
 50304
  41920
    365
-------
3060525
3650000
-------
 589475
```

numbers, write down the Multiplicator, ſetting the loweſt figure thereof 5. juſt under the loweſt figure of the third number, as in the Example you ſee 365. is ſet under 920. the loweſt figures of the numbers above; Next draw a line, and adde together into one ſumme all thoſe foure ſeverall numbers, and the totall will be 3060525. Then write down the Multiplicator, 365. juſt under 306. the three higheſt figures of the aforeſaid totall, and to it adjoyne ſo many Cyphers, as there be ſtill places in that totall, which here in this Example are foure, and ſo that ſumme, 365. is made 3650000. out of this 3650000. ſubſtract the totall afore-found, 3060525. and the remaine will be 589475. which is juſt the ſame product of 1615. multiplied by 365. ſo is the queſtion anſwered by working with an other number in ſtead of the Multiplicand. And thus may you worke a Multiplication obſcurely in the preſence of any one, though a good Arithmetician, and he not perceive how you effect the work, unleſſe he be acquainted with theſe ſpeaking-Rods, whoſe oppoſite ſides with quite contrary numbers, can ſilently produce the ſame concluſions in Multiplications, as their fore-ſides, that is, their Tabulated ſides can doe.

For an other Example, let 7595. be a number given to be multiplyed by 2678. here Tabulate the number 7595. then take thereof the Duple, 15190. in the ſecond line of ſquares

upon the Rods; the Sextuple 45570. in the ſixt line; the Septuple in the ſeventh line, 53165. And the Octuple in the eighth line, 60760. And ſet them all down in order, one below another, and each one a place further towards the right hand then other, as is aforeſhewed, then adde them all together, and the product will be 20339410. as here in the Example the worke plainely appeareth.

7595	2404
2678	2678
15190	4808
45570	14424
53165	16828
60760	19232
10339410	2678
	6440590
	26780000
	20339410

In like manner, if you turne the Rods juſt upſide down, the number ſo turned up, and Tabulated in ſtead of 7595. the number given, will be 2404. Of which take the Duple, 4808. The Sextuple 14424. The Septuple 16828. And the Octuple, 19232. and ſet all theſe foure numbers thus taken from off the Rods, one beneath another, and every one in order one place lower towards the right hand then the next above, then under all theſe foure numbers, ſet down the Multiplicator 2678. juſt underneath the loweſt

loweſt figures of the laſt and loweſt product, And then adde all theſe five numbers together, and the totall will be 6440590. Now becauſe the higheſt figures of the totall, are greater then the higheſt figures of the Multiplicator, as 64. is greater then 26. and ſo cannot be taken out of it, therefore ſet the Multiplicator 2678. one place higher towards the left hand then the totall, and in order, and then adjoyne foure Cyphers to 2678. the Multiplicator, to make the number of places thereof equall to the reſidue of the places in the totall, and then it will be 26780000. being of eight places, that is, one more then the totall, and therefore the ſaid totall may be taken out of it; Now therefore out of this 26780000. Subſtract 6440590. and there will remaine 2033910. which is the true product of 7595. multiplyed by 2678. If you marke well theſe Examples afore delivered, I doubt not but they will give you ſufficient inſtruction in this Rule of Multiplication by the Rods, yet I have here ſet down two Examples more of Multiplication, ready wrought, and ſo proceed to Diviſion, which is the next Rule of Arithmetick.

740856.
4253
2963424
1481712
3704280
2222568
3150860560.

8418565.
37482
25255695
58929955
33674260
67348520
16837130.
315544653330

CHAP. V.

Of Diviſion by the Rods.

DIviſion is a diſtributing of a greater number by the units of a leſſer; Or, Diviſion is an Arithmeticall producing of a third number, in reſpect to two propounded numbers, which third number ſo often containeth an unite, as the greater of the two numbers propounded containeth the leſſe.

Diviſion conſiſteth of three parts, or Numbers, Two whereof are given; the one of which being the greater and is the number to be divided, is called the Dividend; The leſſer number of the two, being that whereby the diviſion is to be made, is called the Diviſor; The third number is the number produced by the diviſion, and is called the Quotient.

Diviſion

Diviſion is the ſame to Subſtraction, that Multiplication is to Addition, for as Multiplication is a brief working of many Additions, ſo Diviſion is a brief working of many Subſtractions; Both of them working according to an even proportion, the one upwards, to the manifeſtation of how many, or how much; The other working downwards, to the manifeſtation of how many times ſuch a number is contained in ſo much, or in ſo many; As if it be demanded how many times 140. is in 6160. by continuall ſubſtracting of 140. from 6160. untill nothing remaineth, (or untill ſo ſmall a ſumme doe remain, that 140. cannot be taken out of it,) And we ſhall finde we may make 44. ſuch ſubſtractions; or if we demand how many times 44. is in 6160. by continuall ſubſtraction of 44. ſucceſſively out of 6160. you ſhall finde that you ſhall make 140. ſuch ſubſtractions; And ſo by diviſions, If you divide 6160. by 44. your quotient is 140. Or if you divide 6160. by 140. you ſhall produce in your quotient 44. ſo that what cannot be done but by many ſubſtractions, is done at once by one diviſion, ſeeing then we have already treated largely of Multiplication, let us appropriate, and imploy our ſpeaking-Rods to the uſe, and eaſie working of Diviſion.

To divide by the Rods, you muſt firſt write downe on a paper the dividend, and under it the diviſor, like as you doe in ordinary diviſion by the pen, ſetting the higheſt figure of the diviſor

diviſor next the left hand, under the higheſt figure of the dividend, if it be not greater then it, if it be, then ſet it one place lower; Next you muſt Tabulate the diviſor; this being done you muſt look along downe the lines of ſquares upon the Rods, what number there cometh neereſt to the number of thoſe figures of the dividend, ſtanding over thoſe of the diviſor, and being leſſe then them, which being found, the figure upon the ledge of the Table, or frame, againſt the end of that line of ſquares, muſt be ſet in the quotient for the firſt figure thereof; then ſubſtract the number found upon the Rods, from the number of the dividend ſtanding over the diviſor, & ſet the remaine over them; then as in ordinary diviſion, remove the diviſor one place forwards towards the right hand, & look upon the Rods againe, for the number that will neereſt take away the number of the dividend ſtanding over the diviſor, and ſo leave a remainer leſſe then the diviſor, the figure on the ledge againſt that line of ſquares wherein you found your number, is the ſecond figure for the quotient, which being ſet downe, ſubſtract the number found upon that line out of the number ſtanding over the diviſor, and ſet the remainer over the head of the ſame, as in ordinary diviſion; and ſo you muſt proceed with all the reſt of the work; and note this, that if at any time the number remaining, and ſtanding over the diviſor, be leſſe then the ſaid diviſor or Tabulated number,

ſo

ſo that you cannot take it out of them, then muſt you put a Cypher in the quotient, and proceed as afore; Severall Examples ſhall make all appeare plaine and eaſie for the underſtanding of the Rule.

Firſt take for Example the number 589475. the number formerly produced in Multiplication, by the multiplying of 1615. by 365. and let it be required to be divided by the ſame 365. therefore ſet down 589475 the dividend, and under the three higheſt figures 589. thereof, write your diviſor 365. next Tabulate the diviſor 365. and then look upon the Rods what number there cometh neereſt unto 589. that part of the dividend ſtanding over the diviſor, and is leſſe then it, which you ſhall at firſt ſight finde to be the very number it ſelfe, 365. for the number in the ſecond line of ſquares is 730. which is greater then 589. and ſo cannot be taken out of it, therefore becauſe the figure againſt it on the ledge is but 1. you muſt put 1 in the quotient, and ſubſtract 365. from 589. and there remaineth 224. to ſet over 589. and then cancell the 589. becauſe it is done with all. Thus have you found the firſt figure of the quotient. Now for the ſecond figure, look again over the Rods, down along the lines of ſquares for the number that cometh neereſt the number 2244. and is leſſe then it. and you ſhall finde in the ſixt line upon the Rods, this number 2190. which of any number upon the Rods leſſe then 2244 cometh

neereſt unto it, therefore put 6. in the quotient for the ſecond figure thereof; then ſet downe 2190. under 2244. and ſubſtract it there from, and there will remaine 54. to be ſet over 44. the two loweſt figures of 2244. cancell the 2244. and the worke of the ſecond figure is ended, and the work will ſtand as in the Example.

Then for the third figure of the quotient, look firſt upon the dividend, and there ſhall you ſee that the figures out of which the third figure of the quotient is to be taken, is 547. Then look upon the Rods, what number there cometh neereſt to it, and at firſt ſight it will appear to be the firſt number, which is the diviſor it ſelfe, 365. therefore put 1. in the quotient for the third figure of the Root, and ſubſtract 365. from 547. and there remaineth 182. which ſet over the head of 547. and cancell the ſame 547. and then is the work of the third figure ended.

```
224
589475 (1
365
    5
  224
  589475 (16
  365
  2190
```

And

And now ſeeing there is yet one figure in the dividend ſtill uncancelled, which is 5. therefore here is yet one figure to come into the quotient, now this figure 5. with the laſt remainder 182. make 1825. the number out of which the fourth figure is to be taken. To finde which fourth figure, take a review over the Rods for the number that cometh neereſt unto 1825. and is leſſe then it. In the fift line of ſquares you ſhall finde the very number it ſelfe, 1825. therefore put 5. in the quotient, for the laſt figure thereof. And if you take 1825. from 1825. there will nothing remaine, and ſo is the work finiſhed. Whereby it appeareth, that in 589475. you may have 365. 1615. times, and from hence we may learne that Diviſion is a true and perfect examination, and certaine proofe of Multiplication, and likewiſe that Multiplication is the examination, and proofe of Diviſion.

1
5
22482
589475 (161
365
2190
365
1
5
22482
589475 (1615
365
2190
365
1825

Example 2. Now on the contrary, let it be required to divide 589475. by 1615. that is, as much as to ſay, how many times 1615. are in 589475. here the greater number 589475. is the

the dividend, and 1615. is the diviſor, being, as it muſt be, the leſſer number, therefore, as in the former Example, write down the dividend on a piece of paper, as here in this Example, and draw a quotient line. Then Tabulate 1615. the diviſor, and then look over upon the lines of ſquares on the Rods, what number there will come neereſt to the foure firſt figures of the dividend, 5894. and withall is leſſe then them, ſo that being from them ſubſtracted, a remainder may be left leſſe then the diviſor 1615. And you ſhall finde the number 4845. which ſtandeth in the third line of ſquares, to be that number, therefore put 3. in the quotient, and ſet 4845. under the foure firſt and higheſt figures of the dividend, 5894. and ſubſtract 4845. out of the ſame 5894. and there remaineth 1049. which muſt be ſet over the head of 5894. and cancell the ſame 5894. as in the preſent Example, and ſo is the work of the firſt figure of the quotient ended.

1049.
589475 (3
4845

You ſee here are two figures in the dividend uncancelled, and therefore two figures more are to come into the quotient; to finde the next figure then, obſerve, that the remaine 1049. and 7. the next figure of the dividend uncancelled, make, both being joyned together, 10497. out of which you muſt take the diviſor 1615. ſo often as may be, by looking along down

down the lines of ſquares upon the Rods, you ſhall perceive that in the ſixt line of ſquares, 9690. the Sextuple of the diviſor 1615. is the very number, of all the numbers on the Rods, that being leſſe then the number 10497. will yet neereſt take it away, leaving a remainder leſſe then 1615. the diviſor, therefore put 6. in the quotient, and write 9690. under 10497. noting this alwayes, that you ſet the loweſt figure of the number to be ſubſtracted, directly under the loweſt figure of the number out of which it is to be ſubſtracted, and the reſt in order towards the left hand, as here in this Example, where ſubſtracting 9690. from 10497. there remaineth 807. now Subſtraction being made, and the figures cancelled, the work will ſtand as in the Example.

80
1049
589475 (36
4845
9690

Having ſtill one figure to bring into the quotient, behold, that the remaine 807. and the 5. that remaineth make 8075. out of which the laſt figure of the quotient is to be found. Therefore proceed as before, ſeeking amongſt the lines of ſquares upon the Rods, for ſuch a number as will come neereſt to the number 8075. In the fift line, againſt the

80
1049
589475 (365.
4845
9690
8075

the figure 5. you ſhall finde the very number it ſelfe 8075. therefore put 5. in the quotient for the third and laſt figure of the Roote, and if you write 8075. under 8075. above, and compare them together, you ſhall ſee no difference, and therefore upon Subſtraction there will be no remainer; Thus is the work finiſhed, and the quotient is 365. ſhewing that 1615 is had juſt 365. times in 589475. the dividend.

For a third Example, let this number 861094. be a number given to be divided by 432. Here as before, Tabulate the diviſor 432. and write the dividend 861094. in a paper, as in the Example annexed. Now conſider that there be three figures in the diviſor, and that they may be taken out of 861. the three firſt figures of the dividend, and further you may ſee they can be had but once, for the ſecond number upon the Rods is 864. which is greater then 861. and therefore cannot be taken out of it, put 1. then in the quotient, and ſubſtract that number 432. from 861. and there reſteth 429. to be ſet over head of the ſame 861. This 429. with the 0. adjoyned make 4290.

429	
861094	(1
432	

out of which the ſecond figure of the quotient is to be ſought for; to doe which, ſeek out upon the Rods the number that neereſt cometh unto, but is leſſe then the ſame 4290. which you ſhall finde to be the number 3888. in the ninth

the ninth line of ſquares upon the Rods, therefore put 9. in the quotient, for the ſecond figure thereof, and ſet 3888. under 4290. makeing Subſtraction, and cancelling 4290. ſetting the remainder 402. over head, and the work of the ſecond figure of the quotient is at an end, this remainer 402. with the 9. in the next place uncancelled, adjoyned to it, makes 4029. in which the third figure for the quotient is to be ſought out.

```
  40
 4292
861094 (19
 432
 3888

   1
  404
 42921
861094 (199
 432
 3888
  3888
```

For this third figure, ſearch over the Rods for ſuch a number as cometh neereſt unto, and is leſſe then that number 4029. and it will be found to be that in the ninth line, *viz.* 3888. put therefore 9. in the quotient for the third figure thereof, and ſubſtract 3888. from 4029. and there remaineth 141. Now this 141. with the 4. that is yet uncancelled of the dividend, makes 1414. Now to get the fourth and laſt figure into the quotient, aske your vocables once againe for a number that will come neereſt unto 1414. and be leſſe then it, and they

will

will readily anſwer you, that you muſt take 1296. the number in their third line of ſquares, and ſubſtract it from your number 1414. which being done, your remainer will be 118. and becauſe you found your number in the third line of ſquares, you are to put 3. in the quotient for the fourth and laſt figure thereof; Laſtly, ſet the remainer 118. over a line for the numerator of a fraction, and the diviſor 432. beneath the line for the denominator, and your diviſion is ended, the quotient being 1993 $\frac{118}{432}$. and ſtandeth as you ſee in the Example.

```
   11
  404
 429218
 861094 (1993 118/432
 432
 3888
  3888
   1296
```

When you have a fraction as here you have, and would have the trueſt eſtimate and value thereof, then the beſt and eaſieſt way is to work it out by the Rules of decimall Arithmetick, which is thus done, Adde one, two, or three Cyphers, or more if you will, unto the Remainder and then continue the work as if it were whole numbers, when you have done you will have ſo many fraction figures, as you added Cyphers, whoſe denominator will be a unite with ſo many Cyphers as you have fraction figures; If you adde one Cypher you ſhall have a fraction in the tenth parts of an unite, or, which is all one, in Primes; if you adde two Cyphers, then ſhall your fraction be in the hundred parts of an unite,

unite, or in Primes, and ſeconds; If you adde three Cyphers, you ſhall have your fraction in the 1000. parts of an unite, or in Primes, ſeconds, and thirds. In this Example we will adde three Cyphers to 118. the Remainder, and then it will be 118000. and we will continue the diviſion to finde out thoſe three fraction figures, in roome and ſtead of them old ones.

The Rods continuing Tabulated as they were, ſeek out on them, for ſuch a number as will come neereſt unto 1180. which you will finde, will be 864. in the ſecond line upon the Rods, therefore put 2. in the quotient, and ſubſtract 864. from 1180. and the remaine is 316 which with the next 0. is 3160 then look againe for a number that will come neereſt unto 3160. and that you ſhall have delivered unto you in the ſeventh line of ſquares, and is 3024. therefore put 7. in the quotient for the ſecond fraction figure, and ſubſtract 3024. from 3160. and you will leave 136. this being ſet over 3160. and that cancelled, it will appeare preſently that the 136. and the 0. that is left uncancelled, make 1360. now

316
118000 (2
864

13
3166
118000 (27
864
3024

ſeek

ſeek upon the Rods againe,	13
what number wil come neer-	31664
eſt unto 1360. and be yet	118000 (273.
leſſe then it; In the third line	854
you have the number 1296.	3024
which is the number that	1296

will ſerve the turne, then put 3 in the quotient for the third fraction figure; next ſet 1296. under 1364. and ſubſtract it therefrom, and you will have 64 remaining. Thus have you three fraction figures in the quotient, *viz.* 273. and doe ſignifie 273 parts of 1000. ſo that the quotient fraction that before was $\frac{118}{432}$ is now $\frac{273}{1000}$. and being adjoyned to the quotient of the whole parts afore found, maketh it 1993. $\frac{273}{1000}$ That is to ſay, 1993. and 2. tenth parts, 7. hundred parts, and 3. thouſand parts. Or according to *Simon Stevens*, 2. primes, 7. ſeconds, and 3. thirds; Or more briefly thus, $2.^{I}\ 7.^{2}\ 3.^{3}$ Or elſe thus, $2.^{I}\ 7^{II}\ 3.^{III}$ and the whole quotient is 1993. $2^{I}\ 7^{II}\ 3.^{III}$ The like is to be obſerved in any other diviſion where there is a remainder left; Diligent practice in this Art, as in all others, bringeth perfection. Thoſe that deſire a full and through inſtruction in the Art of Arithmetick, may read M^r. *Wingats* Book of Naturall and Artificiall Arithmetick, as alſo *Records* ground of Arts, *Taps* pathway to knowledge, and *Johnſons* Arithmetick, wherein they may have abundant ſatisfaction. If in any thing I am to tedious,

tedious, as ſome may happily thinke me to be, it is, becauſe I would be plaine, for I had rather be too plaine, then any whit obſcure.

CHAP. VI.

Of the Extraction of Roots.

1. *The Deſcription of the Lamina and the fabrick thereof.*

IN Extraction of the Square and Cube Roote by the Rods, the Lamina mentioned in the firſt Chapter is to be uſed; This Lamina is a piece of wood, or of ſuch other ſubſtance as the Rods are made of, and of equall length with the Rods, and the breadth thereof is about the breadth of three of the Rods layed cloſe together; Upon one ſide are inſcribed Numbers concerning only the Extraction of the Square Root, under the letter S. On the other ſide are inſcribed figures concerning only the Extraction of the Cube Root, and noted with this letter C. The breadth of this Lamina, on both the ſides, is divided into three parts or Collumns, by lines drawn through the length thereof: And the length of this Lamina is divided into nine equall parts, as the Rods are; and upon that ſide of the Lamina that is for the Square Root, in thoſe nine diviſions, in the Column next the right hand are inſcribed the nine digits, 1. 2. 3. 4. 5. 6. 7. 8. 9. In the middle Column are the duples of theſe nine digits, as 2. 4. 6. 8. 10.

seek upon the Rods againe, 13
what number wil come neer- 31664
est unto 1360. and be yet 118000 (273.
lesse then it; In the third line 864
you have the number 1296. 3024
which is the number that 1296
will serve the turne, then put

3. in the quotient for the third fraction figure; next set 1296. under 1364. and substract it therefrom, and you will have 64 remaining. Thus have you three fraction figures in the quotient, *viz.* 273. and doe signifie 273 parts of 1000. so that the quotient fraction that before was $\frac{118}{432}$ is now $\frac{273}{1000.}$ and being adjoyned to the quotient of the whole parts before found, maketh it 1993. $\frac{273}{1000}$ That is to say, 1993. and 2. tenth parts, 7. hundred parts, and 3. thousand parts. Or according to *Simon Stevens*, 2. primes, 7. seconds, and 3. thirds; Or more briefly thus, $2.^{I}\ 7.^{2}\ 3.^{3}$ Or else thus, $2.^{I}\ 7^{II}\ 3.^{III}$ and the whole quotient is 1993 $2^{I}\ 7^{II}\ 3.^{III}$ The like is to be observed in any other division where there is a remainder left; Diligent practice in this Art, as in all others, bringeth perfection. Those that desire a full and through instruction in the Art of Arithmetick, may read M^r. *Wingats* Book of Naturall and Artificiall Arithmetick, as also *Records* ground of Arts, *Taps* pathway to knowledge, and *Johnsons* Arithmetick, wherein they may have abundant satisfaction. If in any thing I am to tedious,

tedious, as ſome may happily thinke me to be, it is, becauſe I would be plaine, for I had rather be too plaine, then any whit obſcure.

CHAP. VI.

Of the Extraction of Roots.

1. *The Deſcription of the Lamina and the fabrick thereof.*

IN Extraction of the Square and Cube Roote by the Rods, the Lamina mentioned in the firſt Chapter is to be uſed; This Lamina is a piece of wood, or of ſuch other ſubſtance as the Rods are made of, and of equall length with the Rods, and the breadth thereof is about the breadth of three of the Rods layed cloſe together; Upon one ſide are inſcribed Numbers concerning only the Extraction of the Square Root, under the letter S. On the other ſide are inſcribed figures concerning only the Extraction of the Cube Root, and noted with this letter C. The breadth of this Lamina, on both the ſides, is divided into three parts or Collumns, by lines drawn through the length thereof: And the length of this Lamina is divided into nine equall parts, as the Rods are; and upon that ſide of the Lamina that is for the Square Root, in thoſe nine diviſions, in the Column next the right hand are inſcribed the nine digits, 1. 2. 3. 4. 5. 6. 7. 8. 9. In the middle Column are the duples of theſe nine digits, as 2. 4. 6. 8. 10.

10. 12. 14. 16. 18. The nine parts of the third Column are croſſed with Diagonall lines, as the Rods are, and in that Column are inſcribed the ſquares of theſe nine digits, that is their products, they being multiplied by themſelves, each one ſeverally, as 1. 4. 9. 16. 25. 36. 49 64. 81. Upon the other ſide or face of this Lamina, in that firſt Column next the right hand, are inſcribed the nine digits, as was on the other ſide; In the middle Column are the ſquares of thoſe nine digits inſcribed; In that Column next the left hand, the nine diviſions are alſo divided by Diagonall lines, as that on the other ſide was; And therein are inſcribed the Cubes of thoſe nine digits, that is, the ſquare of the digit multiplied againe by that digit it ſelfe, as 1. 8. 27. 64. 125. 216. 343. 512. 729. But for a full deſcription of this Lamina, behold the forme thereof, which will inſtruct you better then many words.

The two faces of this Lamina doe repreſent the ordinary Table of Squares and Cubes, made to the nine digits, and by the ordinary Arithmeticall working by the Pen, is required to be learned by heart, for the more ready proceeding in the work of Extractions, but by our Rods we need no ſuch charge of memory, and herein the excellency of the Rods will appeare; But of Roots, or Rooted numbers, we will meddle with no more, but only the Square and Cube, as being only the moſt uſefull. As for ſquare

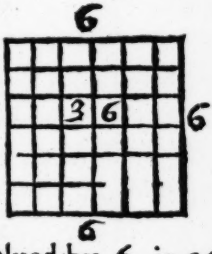
Square

Squares, Surlolids, and many more, they come ſeldome in uſe; for my part I never had occaſion for any more then the Square and Cube, ſave only for triall of ſome experiments, and working of ſome Concluſions Mathematicall, for my private inſtruction and recreation.

The Extraction of the Square Roote defined.

TO extract the ſquare Root of any number given, is to finde ſuch a number, as being multiplied by it ſelf, produceth againe that firſt given number; as in Diviſion, the Diviſor and quotient multiplyed together, produceth the dividend; even ſo here, the Root and number found being multiplyed by it ſelf, produceth again that number firſt given. And ſo *Ramus* defineth a Quadrat to be a number multiplyed by it ſelfe.

What the Extraction of the Square Root is, may appeare by this Diagram, for having a great Square given, conſiſting of 36 little ſquares, & the ſide, or Root thereof required, that is, what number of little ſquares multiplyed by themſelves will produce the ſame great ſquare, the figure ſheweth it to bee 6. little ſquares, for 6. being multiplyed by 6. is 36. As if you have 36. little ſquares of a foot ſquare a piece, and lay them into 6. rankes or rowes, by 6. in a rank, there



will be produced a great ſquare of 6. little ſquares of a ſide every way, and thoſe 6. little ſquares upon one ſide are ſaid to be the Root.

Square numbers are either ſingle, ſuch as are the products of the nine digits, being multilpyed by themſelves, and are all expreſſed upon the Lamina; Or elſe compound, which are ſuch as are produced by multiplying any number of many places by it ſelfe. The leaſt compound number that is, is 100. and is produced by multiplying of 10. by it ſelfe, but the greateſt compound number, no man I thinke is able to expreſſe.

The Extraction of the Cube Root defined.

A Cube by *Peter Ramus* is defined to be a right angled *Parallele pipedum* of equall ſides, and thoſe ſides 12. his ſolid angles 8. and the plaine angles 24.

The Extraction of the Cube Root, by Mr. *Wingate* is defined to be ſuch a Rule, by which having a number given, we can finde out another number, which being multiplyed by it ſelfe firſt, and then by his product, will produce the number firſt given.

In the Extraction of the Cube Root, the number given is alwayes conceived and underſtood to be a certaine number of little Cubes, comprehended within one intire great Cube, and the Cube Root required, is the number of little Cubes in the ſide, or edge of that great Cube;

Cube; As if you take 64. little Cubes, as dice, (for your dice are perfect little Cubes,) and lay them in 8. rowes or rankes close together, by 8. in a ranke, and you shall have a square, containing 64. Cubes, whose side is 8. Cubes every way; now if upon these 64. Cubes you lay Eight such laynes of Cubes, of 64. in a layne, you shall raise, or produce a great Cube, that will comprehend 512. of those little Cubes; Therefore 512. is said to be a Cube number, and 8. is his Cubick Root, because 8. Cubes be in the side or edge of the same great Cube.

Of Cubick numbers, some be single, and some be compound; A single Cube number is such a number as hath for his Root but only one single figure or digit, and is alwayes lesse then 1000. and they be all inscribed upon the Lamina, as 343. is a single Cube number, because his Root is 7. consisting but of one figure; A compound Cube number, is such a number as hath for his Root such a number, as consisteth of more figures then one, as 1728. is a compound Cube number, because his Root is 12. consisting of two figures.

CHAP. VII.

The Extraction of the Square Root.

TO extract the Square Root of any number, you must first prepare it, that is, set downe

the number on a paper, then under the firſt and loweſt figure next the right hand, make a point with your pen, and under the third figure make another, under the fifth another point, and ſo forth, under every ſecond figure of the number make a point, alwayes leaving between each point one figure unpointed, according to the ordinary Rule by the pen; this being done, you ſhall ſee how many figures will be in the Root, for ſo many points as you have, ſo many figures ſhall you bring into the quotient for the ſquare Root, of the number given; next draw a quotient line, as in Diviſion, and your number is ready prepared for Operation, and will ſtand as in the Example following, where the number given is 119025. and the Root ſquare thereof is required, this number being ſet, and pointed, as afore is ſhewed, you may perceive that the Root thereof will be of three figures, becauſe there be three points under the number given, the two figures belonging to the higheſt point next the left hand are 11. the two figures belonging to the ſecond point are 90. and the two figures belonging to the third point are 25. and the figures for the Root anſwerable to thoſe ſeverall points are to be found by the Rods, as followeth.

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Take the frame, the Rods, and Lamina, and lay them before you; and firſt place the Lamina in the frame next to the left hand ledge, with that

that ſide upwards whereupon are the inſcriptions belonging to the ſquare Root, and marked at the top with the Letter S. then conſider what is the greateſt ſquare number in 11. the figures belonging to the firſt point; The Lamina preſently ſheweth you that the greateſt ſquare nūber in 11. is 9. & his Root is 3. for 3. times 3 is 9. therefore put 3. in the quotient for the firſt figure of the Root, then ſet 9. under the 11. and ſubſtract it therefrom, and there will remaine 2. this 2. ſet over 11. and cancell the 11. as you uſe to doe in Diviſion, and ſo you have gained the firſt figure of the Root, and the worke will ſtand as in this Example.

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Having the firſt figure of the Root, to get the ſecond, and ſo all the reſt in order, you muſt proceed in this manner; duple the Root found, which duple place, or Tabulate upon the Rods between the Lamina and the ledge of the frame; As in this example, the duple of 3. the Root found is 6. therefore place a Rod that hath in his top or upper ſquare 6. between the ledge and the Lamina; Then look upon your number given, what figures, or number it is that belongeth unto the ſecond point, which you ſhall ſee will be 290. in this our Example; Then turne your eye to the Lamina and Rod now Tabulated, and ſearch thereupon what number will (being leſſe yet) come neereſt unto 290. the

number out of which the ſecond figure of the Root is to bee found, And there you may ſoon ſee it is the number 256. which of any number upon the Rods, leſſe then 290. cometh neereſt thereunto, for the next greater number upon the Rods, above 256. is 325. which is greater then 290. and therefore cannot be taken out of it; but 256. is the only number to worke withall, againſt which, on the ledge, and Lamina, is this figure 4. this 4. muſt you put in the quotient for the ſecond figure of the Root, and then ſubſtract 256. out of that 290. and there will reſt 34. this 34. ſet over the 290 in its due place, and cancell the 290. and the worke will ſtand as in the example; If you pleaſe, you may write your numbers to be ſubſtracted, under the number out of which Subſtraction is to be made, as I have done here in this Example, for inſtruction ſake, or you may omit that if you pleaſe, being you have them before you upon the Rods.

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 234
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And now for the third figure of the Root, looke upon the number given, and there you ſhall ſee that the Remainder 34. with the two figures 25. ſtil uncancelled, belonging to the third point, being all joyned together, make 3425. Out of which the third figure of the Root is to be extracted; To finde out what this third figure ſhall be, duple the Root found already, which

is

is thus done very readily; Take forth a Rod that on his top Square hath 8. the duple of 4. the figure laſt found, and this Rod put into the frame between the Lamina and the Rod that is already Tabulated; This being done, you have no more to doe, but to looke over the Rods and Lamina for ſuch a number, as will come neereſt unto the number 3425. that belongeth to the third point, and is leſſe then it, and the figure that you ſee againſt that number ſo found, put in the quotient for the third figure of the Root; Thus looking upon the Rods, you ſhall at the firſt ſight finde the very number it ſelf 3425. that belongeth to the third point, in the fifth line of ſquares, againſt the figure 5. therefore put 5.

234
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256
3425

in the quotient for the third figure of the Root, and if you ſubſtract 3425. the number now found from 3425. that number belonging to the third point, there will be no remainder, ſo is the worke done, and the number given, 119025. is a perfect ſquare number, and the ſquare Root thereof is 345. which was the thing required to be found.

Now if you multiply this 345. by it ſelfe, it produceth 119025. the firſt given number, which proveth the worke to be truly wrought; for note this evermore, that for proofe of the Extracting the ſquare Root, you muſt multiply the

Root found by it ſelfe, (to the product adding the Remaine, if any be) and the totall will produce the firſt number given, if the work be truly wrought, otherwaies not.

For a 2d. Example, let there be given this number 117716237694. and the Root thereof required; Now to performe the worke, firſt write downe the number, and then prepare it with points and a quotient line, as you were inſtructed before in the former Example; This being done, the number will appeare as here you ſee, in this Example; Now in 11. the figures belonging to the higheſt point, the greateſt ſquare number is 9. whoſe Roote is 3. and 2. remaineth to be ſet over head; Now for the ſecond figure of the Root, Tabulate the duple of the Root found, and that is no more to doe, but to place a Rod that hath 6. the duple of 3. the Root found, in his top ſquare, between the Lamina and the Ledge, and on the left hand of the Lamina, the ſaid Lamina being Tabulated with that face upward, that is, for the ſquare Root; then ſeeing that the number belonging to the ſecond point, out of which the ſecond figure is to be extracted, is in this Example 277. therefore ſearch upon your Tabulated Rod and Lamina for ſuch a number, as will come neereſt to that 277. which you

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you ſhall quickly finde to be 256. and right againſt it, on the right hand Column of the Lamina is the figure 4. therefore put 4. in the quotient for the 2d. figure of the Root, and ſubſtract 256. from 277. and ſet the remainder 21. over the head of it, and alſo cancell the 277. and ſo have you done with your ſecond point.

And now for the third figure of the Root, obſerve, that the 21 remaining with the other 16. the two figures uncancelled belonging to the third point, being joyned together, make 2116. out of which the ſame third figure is to be extracted; to performe which worke, take a Rod that carrieth in his upper ſquare the figure 8. the duple of 4. the figure laſt found, and put that Rod into the frame between the Lamina and the other Rod before Tabulated, then look for the nũber upon thoſe two Rods, and Lamina that will neereſt take away 2116. the number belonging to that third point, and at firſt ſight you ſhall finde that the next number leſſer then 2116. is 2049. and his figure for the quotient 3. therefore put 3. in the quotient, for the third figure of the Root, and ſubſtract 2049. from his reſpective number 2116. and there remaineth 67. to ſet over head, this being done,

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2049

and the 2116 being cancelled, you have done with the third point, and third figure, and are to proceed to the fourth.

Where firſt you ſee that the 67. laſt remaining, with the 23. make 6723. the figures belonging to the fourth point, whereout you muſt extract the fourth figure of the Root. Therefore goe on as before, taking ſuch a Rod, as in its top ſquare hath 6. the duple of 3. the figure laſt found, and Tabulate it between the Lamina, and the other Rods, and then ſeek what number there can be found, that will be leſſe then 6723. but at the very firſt ſight you ſhall ſee no number upon the Rods ſo ſmall as that 6723. for the very firſt number againſt 1. is 6861. which is greater then 6723. and therefore cannot be taken out of it, ſo that here you can put no figure in the quotient, but muſt ſupply the place with a Cypher, therefore put a 0. in the quotient, for the fourth figure of the Root, all the reſt of the number ſtanding as it did; Now to the next point, which is the fifth, you have this number belonging 672376. whereout the fifth figure of the Root is to be found. Now here, in regard your laſt figure of the Root found is a 0. you muſt e-

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ver in ſuch a caſe (in ſtead of putting a Rod, that hath the duple of the figure found in his top ſquare,) you muſt take ſuch a Rod as upon one of his faces, carrieth only Cyphers, and Tabulate it between the Lamina and the other Rods already Tabulated; This being done, queſtion the Rods, what number you muſt take from that number 672376. or what number it is there, that being leſſe then 672376. yet cometh neereſt unto it; and alſo what the figure ſhall be that you muſt put in the quotient for the reſpective figure of the Root; The Rods will ſuddenly reſolve you, that their greateſt number leſſe then 672376. is 617481. and its reſpective figure, for the Root is 9. therefore put 9. in the quotient for the fifth figure of the Root, then if you will write 617481 under 672376. and make ſubſtraction, your remainder wil be 54895. which joyned to the 94. the two laſt figures of the number given, make 5489594. for the number out of which the ſixt and laſt figure is to be found.

To finde this ſixt figure, you muſt Tabulate upon the Rods the duple of the figure laſt found

between

between the Lamina, and the Rods already Tabulated; but here, because the duple of 9. is 18. consisting of two figures, therefore this 18. cannot be Tabulated upon one Rod, as be-before we did use to doe, when the duple was contained of but one figure, now in this case, (and so of all the like) First, Tabulate a Rod bearing 8. in its top square, between the Rods formerly Tabulated, and the Lamina, and next to the Lamina, then for the unite 1. being the highest figure of the 18. you must Tabulate that upon the last and lowest Rod, formerly Tabulated, which is done by encreasing the figure in its top square one unite more then it was before; so here the last Rod before Tabulated, carrying only 0. either turne it, or else take it away, and place such a face of that Rod, or of some other, that hath in his upper square the unite 1. in roome and stead of that face, with Cyphers, so is your number 18. the duple of 9. Tabulated, this done, looke over the Rods, for a number that will come neerest unto 5489594. in the Eight line is this number 5489504. and its respective figure for the Root 8. this 8. put into

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into the quotient, and Subſtraction being made as is uſed to be done, there will remain 90. and ſo is your whole work ended, and the ſquare Root of 117716237694. is 343098. if you multiplie this Root by it ſelf, and to that product adde the 90. that remaineth, you ſhall produce again the firſt number given, which argueth that the work is truly wrought.

But now when any thing remaineth, the Extraction being ended, as here it doth, make a fraction of that remainder as you do in Diviſion, in this manner, Set the number ſo remaining after the Extraction is ended, over a line for Numerator, and for the Denominator, ſet the duple of the whole Root found, with one added thereunto, as here in this example 90. remaineth; this 90. put over a line for the Numerator of the fraction, then double 343098. the Root, and it is 686196. to which adde one unite, and then it will be 686197. this ſet down under the line for Denominator to the fraction, and then the true Root ſquare of the number given will be $343098\frac{90.}{686197}$ and will ſtand as in the example: This is the vulgar, and ordinary way to make a fraction of the remainder.

But the beſt and moſt certain way to attain unto the true value of the fraction remaining, & that to by the Rods very eaſie and ſpeedie, is to adde two, four, or ſix Cyphers to the remainder, and continue the work of Extraction, and then your fraction will be in primes, ſeconds, thirds,

thirds, &c. that is in 10 parts, 100 parts, and 1000 parts, in the ſame manner as in diviſion; for note, that for every two Cyphers that be added or adjoyned to the number given, you ſhall have one fractionall figure in the quotient, which will repreſent the fraction in Decimall parts of an unite, we will adde 6. Cyphers to the remainder in this our laſt example, and it will then be 90000000. and then we will continue the work, therefore Tabulate 16, the duple of 8. the figure laſt found, which to do, put a Rod that carrieth 6. the loweſt figure of 16. next the Lamina, between it and the Rods afore Tabulated, and then inſtead of that Rod laſt in place next the Lamina, put another Rod that hath in his upper ſquare one unite more then that, as here, change the Rod from 8. to 9. and the Rods are Tabulated, and you are now to look out a number that will neereſt take away 9000. the number belonging to the firſt fraction point, but the Rods give you none ſo ſmall, therefore put a 0. in the quotient for the firſt figure of the fraction, and becauſe there is no more to do about this firſt figure, you are next to Tabulate a Rod with Cyphers next the Lamina, and then ſee for a number that will come neereſt unto 900000. the number belonging to the ſecond point of the fraction, but yet you ſhall have none upon the Rods ſo ſmall, therefore put another 0. in the quotient for the ſecond fraction figure: again, Tabulate a Rod with 0. next the Lamina, and you

you ſhall yet againe finde no number on the Rods ſo ſmall as 90000000. the number belonging to the third point, therefore put a third cypher in the quotient for the third figure thereof. Thus have you done with your three points of Cyphers, which you firſt added, but becauſe you are reſolved to get at leaſt one fraction Figure, therefore add Two Cyphers more to the remainder, making it 9000000000. and alſo Tabulate a Rod with 0. next to the Lamina, and then ſee if you can finde a number little enough upon the Rods. And now here at laſt you ſhall finde, one ſignificative figure in the quotient of your Fraction, for the number now belonging to the Fourth Fraction point is 9000000000. conſiſting of 10. places of Figures, And the number tabulated is alſo now become to be of 10. places, and withall the higheſt figures leſſe then the higheſt figures of that number which belongeth to that fourth point, therefore ſeeke upon the Rods for a number leſſe then that 9000000000. and that you ſhall have in the ſecond line upon the Rods, and it is 6861960004. whoſe reſpective figure for the roote is 2. now ſubſtraction being made, there will remaine 2138039996. Thus have you gotten one figure into the quotient of your fraction, and that in the

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9000000000. (0002.
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6861960004

the fourth place Deſcending, and may be thus expreſſed fraction-wiſe $\frac{0002.}{10000.}$ or thus, $_{10000.}^{2.}$ ſignifying 2. parts of 10000. of an Unite, for note that ſo many fractionall points as you bring into the quotient to produce a new numerator, the Denominator is alwaies an Unite, with as many Cyphers as you have made fractionall figures.

343098 $\frac{2}{10000}$

This new found fraction joyned to the whole parts of the Roote found, will ſtand as here in the example; Or elſe without a Denominator, thus, which is all one with that other; Or elſe thus, according to *Simon Stevens*, and is thus to be read 343098 0. primes, 0. ſeconds, 0. thirds, 2. fourths. Theſe Examples might be ſufficient to ſhew the excellent uſe of the Rods in Extracting the ſquare Root of any number; but yet to ſhew the more variety of works, take one example more, and if in any thing I be thought too tedious, know, that it is out of a deſire to plainneſſe, even of ſuch a plainneſſe as is anſwerable to that of the Rods.

343098.0002.

$$343098.\overset{1}{0}.\overset{2}{0}.\overset{3}{0}.\overset{4}{2}.$$

Let there be given this number 97419256. and the ſquare Root thereof required, Write down the number, and prepare it with points under each ſecond figure, and a quotient Line, and then proceed as before, and firſt looke upon the

the Lamina, what is the greateſt ſquare number there, that can be had out of 97. the two figures belonging to the firſt and higheſt point, the Lamina ſheweth that it is 81. whoſe Root is 9. put this 9. in the quotient for the firſt figure thereof, and then ſubſtract 81. from 97. and that 97. cancell, the remaine is 16. for the ſecond figure, Tabulate 18. the Duple of 9. upon two Rods, between the Lamina and the Ledge, and then upon thoſe two Rods and Lamina ſeeke out the number that comes neereſt to 1641. the number to the ſecond point belonging, and that you ſhall finde to be the number 1504. and his reſpective figure for the Roote 8. which being put into the quotient, and ſubſtraction made, according to the inſtructions afore delivered, the number remaining to the Third point will be 13792. and to finde out his proper figure for the Root, Tabulate 16. the Duple of the 8. laſt found, in this manner, place a Rod that carrieth in his top ſquare the figure 6. betwixt the Lamina and the former Rods, and increaſe the former lowermoſt Rod one unite, by changing it from 8. to 9. then ſhall you ſee the number upon the Rods neereſt unto 13792. is 13769. in the ſeventh line, and after Subſtractiō made, there will reſt 23. making the

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97419256 (9870 $\frac{5236}{19741}$
81
1504
13769

the number for the leaſt point to be 2356. now to find the reſpective figure of that fourth point, Tabulate 14. the duple of 7. as before you were inſtructed, and then you ſhall ſee at the very firſt, that no number upon the Rods is ſo ſmall as that 2356. the number belonging to the laſt point, therefore put 0. into the quotient for the laſt figure of the Root, and ſo have you ended the work, for the whole part of the Root ſought for, which in this Example appeareth to bee 9870. and the Remainder 2356. But now to make a Fraction of this Remainder, as you were before ſhewed, ſet the ſame 2356. over a line, at the end of the whole part of the Root found 9870. and then duple the Root found, and to that duple adde one unite, and the totall will bee 19741. which ſet under the line for Denominator, and then the whole work is finiſhed, and the true Root found anſwering the demand is $9870\frac{2356.}{19741.}$ and ſtandeth as in the example it appeareth.

But if you deſire to be yet more exact, and would have the trueſt value and eſtimate of your fraction; then turn it into a Decimall, and proceed as before; firſt adde to the remainder ſo many times two Cyphers as you deſire to have figures for your numerator of your new fraction, that is to ſay, two Cyphers if you would have but only one figure, four Cyphers for two figures, ſix for three figures, and ſo forth, for as many

many as you would have, and untill you think your fraction is ſmall enough: In this example we adde to the remainder three poynts of Cyphers, that is ſix Cyphers, becauſe we would have three Decimall figures in our fraction Root; then Tabulate the duble of that figure of the Root laſt found, but becauſe that is a 0. which doth neither increaſe, nor diminiſh, therefore Tabulate a 0. next the Lamina, between it & the other Rods, next ſee upon the Rods what number there will come neereſt to 235600. the number that now belongeth to the higheſt point of the fraction points, & that is only the very firſt, *viz.* 197401. that will do it, therefore put 1. in the quotient, for the firſt fraction figure, and then make Subſtraction, and there will remain for the ſecond fraction point 3819900.

To finde the ſecond fraction figure, Tabulate 2. the duple of 1. and ſeek the number that commeth neereſt to that remainder 3819900. and that is again only the firſt, therefore put 1. in the quotient, and make Subſtraction, and then to your third point will belong 184587900 and to finde its reſpective figure for the Root, Tabulate 2. the duple of 1. laſt found, and inquire what number upon the Rods will come neereſt to that 184587900. and that you ſhall finde in the ninth line of ſquares to be 177662061. therefore put 9. in the quotient, and when Subſtraction is made, you will have remaining 6925839. thus have you three figures

in

```
        1
        600
      1849238
      381585867
     235699793951
97419256.00000000(1193
          . . . .
     197401
      1974021
      177662061
        512207149
```

in the quotient, which are enough to give the fractions value in any ordinary question; if you please to continue the work the fourth figure will be 3. and now is your fraction turned into a Decimall fraction, whose numerator is 1193. and his Denominator 10000. and being set fraction wayes wil stand thus $\frac{1193}{10000}$ Or it may very wel be expressed without the Denominator, only with a line, or point of distinction, thus, 9870.1193. and so the value of this fraction is 1193. parts of 10000. Or according to *Simon Stevens*. 1. prime, 1. second, 9. thirds. 3. fourths, and more briefly may be thus expressed $1.^{1}\ 1.^{2}\ 9.^{3}\ 3.^{4}$ or thus, $1.^{1}\ 1.^{11}\ 9.^{111}\ 3.^{1111}$ If you will, you may continue the Extraction unto 9. or ten degrees, but 3. or 4. for ordinary works is enough. If you multiply this Root found 9870. 1193. by it selfe, the Product will bee 97419254.99623249. from whence, by a point or line cut off 8 places of figures, according to the rules of Multiplication in Decimall Arithmetick, and the number remaining towards the left hand,

hand, will want (the fraction conſidered,) but a very little more then one unite of the number firſt given, but if you take the paines but to continue the work to one place lower, it will not want an unite, and ſo the lower you work the fraction, the neerer ſtill you come to the exact truth.

CHAP. VIII.

The Extraction of the Cube Root by the Rods.

TO Extract the Cube Root of any number, you are firſt to write down the number given, whoſe Root is required, and make a point under the loweſt figure next to the right hand, and another point under the fourth figure, and ſo under every third figure, omitting between every two points two figures unpointed, and then ſo many points as you have under your number, ſo many figures ſhall you have in your Root; next draw a quotient line, as in the Extraction of the ſquare Root, this being done, the number is prepared for Extraction, then to go to the work, firſt, ſeek what is the greateſt Cube number in the number ſtanding above, or belonging to the higheſt point next the left hand, which the Lamina will ſhew upon his left ſide of that face for the Cube Root, and in the Column, upon the right

right ſide of the ſame face is the Root thereof, and when either by your memorie or Lamina, you have found the greateſt Cube Root in that number belonging to that firſt point, then (as in Extraction of the ſquare Root) Subſtract the greateſt Cube number, to that firſt point belonging, or that in the number, to the ſaid firſt point belonging, can be found from the ſaid number, and then cancell it, & ſet the remainder over head thereof, as before in the Extraction of the ſquare Root, & put the reſpective digit number found in the quotient, for the firſt figure of the Root: Now to finde the ſecond figure of the Root, (and ſo all the reſt, how many ſoever they be) you muſt alwayes Triple the Root found, and that Triple multiplie again by the Root found, and that laſt product Tabulate upon the Rods on the left hand of the Lamina, as before in the Extraction of the ſquare Root, you did the duple of the Root found, then look upon thoſe Tabulated Rods and Lamina toghther, what number you can finde upon them will come neereſt to the number belonging to the point next following, and leſſe then it, which number is the Diviſor, and the figure on the right hand of the Lamina, is the figure for the Root anſwerable to that point, and that figure put in the quotient for the reſpective figure of the Root, belonging, and anſwerable to that point; but note alwayes that you take the Diviſor ſo often, and no oftner, but that you may

yet

yet also take another number from the number belonging to that point, which other number is square of the Digit new found, multiplied into the former Triple, the product add to the Divisor, with this provisall, that you place this new product one place higher towards the left hand then is the divisor, that is to say, set the lowest place of that new product under the second place of the divisor, the totall of this Addition Substract from the number belonging to the point in action, cancelling the said nnmber, and the remain set over head thereof, as you use to do in Division and Extraction of the square Root; & so proceed to the next point, if you have any more: But to make all plain, we will illustrate this by variety of Examples in all the kindes and differences of works.

First, let 110592 bee a number given, and the Cubick Root thereof required; this Cubick Root is thus found, first prepare your number, that is to say, write it down, and make a point under 2. the lowest figure thereof next the right hand, and one other point under 0. the fourth figure thereof, leaving two figures between unpointed, then draw the quotient line, and then the number will stand ready prepared as in the example, with two points, whereby it appeareth that the Root will consist of two figures, which are to be found out according to the former directions; and first observe that 110. is the number belonging to the first point, and upon

on the Lamina you may alſo obſerve, that the greateſt Cube nũber in that 110. is 64. and his Cube Root 4. therefore put 4. in the quotient, for the firſt figure of the Root, and then Subſtract 64. from 110. and there will remain 46. this 46. ſet over the 110. and cancell the 110. and the work of the firſt point is done, and here you may now obſerve, that the 46. remaining, with the other figures 592. make 46592. which is the number belonging to the ſecond point, and whereout the ſecond figure is to be found.

46
110592 (4
64

To obtain this ſecond figure, proceed in this manner, triple 4. the Root found, and it is 12. and that triple 12 multiplie by the Root found 4. and the product is 48. this product 48. Tabulate upon the Rods on the left hand of the Lamina, between it and the Ledge, then view over theſe Rods and Lamina thus Tabulated, what number there will come neereſt unto 46592. the number belonging to the ſecond point, & be leſſe then it, you ſhall ſee the number that cometh neereſt to it is that in the ninth line, 43929. and his reſpective figure for the Root is 9. now ſquare this 9. and it is 81. this 81. multiplie by the former Triple 12. and it yieldeth 972. this 972. added unto 43929. the number found on the Rods (being ſet in Addition one place

place higher then is ordinary, as was before ſhewed) and the totall will be 53949. which if you compare with 46592. the number belonging to the point in action, you ſhall ſee it is too great to be taken out of it: Whereby it appeareth that you muſt not take 9. for your Root, for by your generall rule you muſt not take the Diviſor no oftner, but that you may take alſo the product made by the ſquare of that new digit number multiplied into the firſt triple, out of that number belonging to that ſecond point, therefore take a leſſe number upon the Rods, as the number 38912. in the eighth line, which will ſurely ſerve the turn, wherefore put 8. in the quotient for the ſecond figure of the Root ſought for, now write (if you will) this number 38912. juſt under 46592. the number belonging to the ſaid ſecond point; then according to the rule. Square this digit 8. new found, and it giveth 64. this 64. multiplie by the former triple 12. produceth 768. write downe under the former number 38912. ſetting the loweſt figure 8. of this new product directly under 1. the ſecond figure of 38912. and its ſecond figure ſix under that third figure

```
 46
110592 (48.
  .  .
 64
 38912
  768
 46592
```

9. and ſo of the other in Order, then adde theſe two numbers together, and the totall will be 46592. which is equall to that number above, therefore if Subſtraction be made, there will nothing remain, and ſo the work is ended, whereby you may conclude, that 110592. the number given, is a right Cubick number, and that 48. is the Cube Root thereof, which was the thing required to be found.

Now if you would at any time prove your work, whether you have wrought truly, or not; multiplie the Root found Cubickly, and adde the remainder, when any is, to that product, and if the totall be the firſt number given, then the work is truly wrought, or elſe not, as here in this example; if you multiplie the Root found 48. by 48. it is 2304. and this 2304. multiplie again by 48. produceth 110592. the number firſt given, and therefore conclude that the work is truly wrought.

For a ſecond example, we will take this number, 41063625. and ſeek the Cube Root thereof, firſt, prepare the number, by writing it down, and making a point under the loweſt figure 5. and another under 3. the fourth figure, and another under 1. the ſeventh figure, and draw the quotient line, theſe three points do declare that the Root will conſiſt of three figures: Now to fall to work, to finde the firſt of them, conſider what the greateſt Cube number in 41. is, which appeareth on the Lamina to be 27. and its Root 3

therefor

therefore put 3. in the quotient for the first figure of the Root, and then ſubſtract 27. from 41. and ſet the remainder 14. over head, and the work of the first figure is ended, and the number that belongeth to the ſecond point is 14063. out of which the ſecond figure is to be found, behold the example: to get this ſecond figure, triple 3. the Root found, makes 9. this triple 9. multiplie by 3. the Root found giveth 27. this product 27. tabulate upon the Rods on the left hand of the Lamina, & then the number that will come neareſt unto that 14063. bolonging to the ſecond point now in action, remembering the former Caution, that it be taken no oftner, but that withall there may be taken from thence alſo the product, produced by multiplying the ſquare of the reſpective figure into the former triple, as here the diviſor may be had five times, but by reaſon of that other number, that muſt alſo be taken from thence, cannot be taken alſo, therefore it can be had but only 4. times, wherefore put 4. in the quotient for the ſecond figure of the Root, and ſet the number 10864. found in that fourth rank of ſquares under the number 14063. the number belonging to the ſecond point, then multiplie 16. the ſquare of 4. the digit now found by 9. the product is 144. this 144. ſet under the former 10864. but according to the former proviſal, one place higher towards

14
41063625. (3.
27

towards the left hand, as set its lower figure 4. under. 6. the second figure of that 10864. the next 4. under 8. and the uppermost being 1. under 0. as you see it stand in the example, then adde these two numbers together, and they make 12304.

```
  1
14759
41063625 (34
 .   .   .
27
10864
 144
12304
```

this take from 14063. leaveth 1759. thus is the work of the second point at an end; behold the example.

Now for the 3. figure of the Root, you are first to observe, that the number belonging to the third and last point is 1759625. from whence the third and last figure of the Root is to be extracted, which figure to finde out, triple the Root found 34. and it is 102. and that multiplie again by 34. the Root found yieldeth 3468. this product 3468. is the divisor, and this Tabulate upon the Rods as before, and joyn the Lamina close to them, then seek upon those Rods & Lamina what number will come neerest unto that 1759625. the number belonging to the third point now in action, (remembering the former Caution, but here is no need of that in the work of this point,) you shall finde the number for the purpose; to be the number 1734125. standing

in

in the fifth line, and its reſpective figure for the Root 5. therefore put 5. in the quotient for the third figure of the Root, now tranſſcribe the number 1734125. from off the Rods into the paper, juſt under the 1759625. then to finde the other number to be hereunto added; ſquare 5. the figure laſt found, and it makes 25. this ſquare 25. multiplie by the former triple 102. and the product is 2550. this ſet under the other number 1734125. according to the former proviſe, as you ſee it ſtand in the example, and adde theſe two numbers together, and their totall will be 1759625. and is equall to that above, belonging to that third point, ſo that if ſubſtraction ſhould be made, there would nothing remain which declareth the number given to be a perfect Cubick number, and the Cubick Root thereof to be 345 which was the thing required to be done; if you will multiplie this Root 345. Cubickly, it produceth the number firſt given 41063625. which proveth the work to be truly wrought,

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 1
14759
41063625(345.
 .   .   .
27
10864
 144
12304
 1734125
    2550
 1759625
```

the like is to be obſerved in all other works of this nature whatſoever.

For a third example, we will take at an adventure this great number 859271650667. and ſeek the Cube Root thereof. This number being prepared with points, and a quotient line, ſheweth by his four points, that his Cube Root will conſiſt of four figures, and by the former directions, the firſt figure will appear to be 9. for the greateſt Cube number in 859. the number belonging to the firſt point, is 729. which taken from that 859 leaveth 130. which with the 271. between that 130. and the next point, make 130271. out of which the ſecond figure of the Root is to be extracted, this ſecond figure by the former rules, will be found to be 5. after the work of this ſecond point is ended, there will be remaining to the third point 1896650. and the Root found is 95. this tripled, and alſo multiplied again by the Root, produceth 27075. for the diviſor, this diviſor tabulated, there is no number to be found upon the Rods ſo ſmall as is 1896650. the number belonging to that third point, therefore put

```
   1
130896
859271650667 (95
 .   .   .   .
729
121625
  675
128375
```

a 0.

a o. in the quotient for the third figure of the Root, and ſo have you done with that third point.

Now to finde the fourth figure anſwerble to the fourth point, you need here do no more, but Tabulate two o. between the Lamina, and the other Rods without any altering of the Rods already Tabulated, and then ſeek the fourth figure as before, the reaſon is, becauſe o. doth neither multiplie nor divide, but only raiſeth the places of figures higher towards the left hand, for here if you triple 950. the Root found, it yieldeth 2850. and this multiplied again by 950. the ſaid Root found produceth 2707500. which is the ſame with that former tabulated number, ſaving only the two Cyphers, and therefore it is, that when there is a o. in the quotient, there needs no more to be done, but to Tabulate two Cyphers between the Lamina and thoſe Rods before Tabulated, when you ſought for that laſt figure, which happeneth to be a o. Now upon

```
   1
100896   3842
859271650667 (9507
  .   .   .   .
729
121625
  675
128375
  1895250343
     139650
  1896646843
```

thoſe Rods thus Tabulated, ſeeke what number upon thoſe Rods and Lamina will come neereſt unto that number, which belongeth to the fourth point, which is here 189665c667. By viewing the Rods, you ſhall finde that number in the ſeventh ranke of ſquares to be the number that will ſerve the turne, *viz.* 1895250343. and its reſpective figure to be put in the quotient 7. To this number adde 139650. the number made by multiplying 49. the ſquare of 7. the Digit new found by 2850. the Triple of the Root afore found, and the totall is 1896646843. This ſubſtracted from that number to the laſt point belonging, leaveth remaining over head 3824.

Thus have you finiſhed all your points, and have found the Cube Root of your number given to be 9507. And being there is a remainder left, it appeareth that the number firſt given is not a perfect Cube number; but the greateſt Cube number therein is 859271646843. and his Cubick Root is 5907. The truth of this worke you may examine by multiplying the Root found Cubickly, which if you do, and adde the remainder to the product, you ſhall produce the firſt number given.

Now for the remainder, to make a fraction thereof in ſuch ſort, that it may aptly expreſſe the neareſt Cube Root, I could ſhew ſeverall wayes delivered by ſeverall Authors how to bring it moſt neereſt to the truth. But for a briefe and eaſie Rule, and which in my conceit

is

is the moſt exact, is, that which that good Artiſt, my old acquaintance Mr. *John Tap* delivereth in his Book of Arithmetick, and which he ſaith, is the Method uſed by *Goſſelin* upon *Tartaglia*. And the Rule in his owne words is this. The Root in whole numbers being extracted, ſet the remainder over a line for numerator, and then for the denominator, triple the Root found, that triple multiply againe by the Root found, and to the product adde the former triple, the totall ſet under the line for denominator. According to this Rule, if you triple the Root found 9507. it giveth 28521. and that multiplied againe by 9507. the Root found produceth 271149147. to this product adde the former triple 28521. and it giveth this totall ſum 271177668. to be ſet under the line for a Denominator to 3824. the remainder; And ſo the neereſt Cube Root of the number given, is found to be, as here it ſtandeth in this Example. This Rule, of a briefe Rule, is the beſt I know.

$9507\frac{28521.}{271177668.}$

But the moſt abſolute and beſt rule to get the Cube Root of any number not Cubick, is this, Adde to the remainder ſo many ſeverall points, or Ternaries of Cyphers, as you deſire to come neerer to the true Roote, (in the ſame manner as you did in the extraction of the ſquare Root) and then continue on the worke for extraction, as you do in whole numbers, and the fraction will be turned into a Decimall fraction, the nu-

merator whereof will not be the remainder, as before it was, but other figures new found, and then ſo many as you adde Ternaries of Cyphers, and the Denominator will have an Unite, with as many Cyphers, as you added Ternaries, or points of Cyphers to the remainder, a ſhort Example will ſerve to explaine this Rule.

Let 2112. be a number given, whoſe Cube Root is required, This number I can perceive is no Cubick number, therefore I ſet it downe, and to it adde three Ternaries of Cyphers, and then prepare it with a quotient line, and points, as you uſe to doe, where by the points you may ſee that you ſhall have two figures for the whole part of the Root, and three that you would have in the fraction. Now to go to worke, the greateſt Cube number in 2. is 1. and 1. is the firſt figure of the Root, and by the former Rules, the ſecond figure of the Root is found to be 2. ſo that the whole part of the Root of that number given 2112. is 12. and the remainder is 348. whereof a fraction is to be made. Thus having done with the whole part, go on now to the fraction, as you uſe to do with whole numbers, for indeed it is no other but a whole number.

Therefore triple 12. the Root found, and it makes 36. that multiply againe by the Root found 432. this product Tabulate, and joyne the Lamnia to the Rods, and you ſhall finde that you may have this Diviſor 8. times out of that num-

ber

ber 384000. the number belonging to the first

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    1 340
   12 315000
1384 848513856
2112.000000000(12.134
.   .   .   .   .

 608
 12
 ---
 728
 ---
 346112
  2304
 ------
 369152
 ------
  12501 627
     31 86
 --------
  12533487
 --------
   1975306864
      20528
 ----------
   1975512144
```

fraction point, put 8. therefore in the quotient for the first fraction figure; when you have finished this worke, as you have beene before instructed, you will finde remaining to the next point 14848000. whose respective figure for the Root will be found to be 3. and to the third point remaineth 2315513000. whose respective figure for the Root is found to be 4. thus have

have you gained three figures into the quotient, for thenumerator of your new fraction, whoſe Denominator will be one Unite, with three Cyphers, becauſe three Ternaries of Cyphers were added, and ſo the Root found is $12_{1000.}^{834.}$ repreſenting 12. and 834. ſuch parts whereof 1000. make one Unite, or $8'3''4'''$ that is to ſay 12. unites, 8 primes, 3. ſeconds, 4. thirds.

If you ſeeke a Denominator for this remainder 384. by that other Rule, you ſhall finde the Root to be $12\frac{384.}{474}$ but this laſt Rule by addition of Cyphers, though not ſo eaſie as that other, yet is the moſt exact, as by triall you ſhall finde. Thus much of the Extraction of Roots.

CHAP.

CHAP. IX.

Of the Rule of Three.

THe rule of Three for the precioufneſs thereof, is called the golden rule, by which, having three numbers given, we finde a fourth, Geometrically proportionall unto them three, and therefore it is called the rule of Three, and is performed upon the Rods in the ſame manner as by the Pen, but without any charge or trouble to the memory; this rule of Three is either direct or Reverſe, and both are wrought by Multiplication and Diviſion.

In the rule of Three direct, multiplie the third number, being that on which the queſtion dependeth by the ſecond, and that product divide by the firſt, the quotient is the fourth number ſought for, as for example. If 12. moneths give 365. dayes, what will 27 moneths give? for anſwer hereunto by the Rods, Tabulate one of the the two numbers that are to be multiplied together, as here 365. and 27. are the two numbers that are to be multiplied together, therefore tabulate one of them for Multiplicand, and gather the product by the other, and which way ſoever you work, whether you make 365 the Multiplicand, or 27. the product will be 9855. this product muſt be divided by

by the first term in the rule 12. therefore Tabulate 12. the present divisor, and then seek how often it can be had out of 98. the two highest figures of the pesent dividend, which at the first view you may see will be 8. times, put 8. therefore in the quotient, and substract eight times 12. or 96. from that 98. and there resteth 2. now proceed on with the work, as in Division you were taught, and the quotient will be found to be 821 $\frac{3}{12}$ or 821 $\frac{1}{4}$. and according to Decimall Arithmetick, 821. 2. primes, 5. seconds, and is as much as to say 821. dayes, and a quarter.

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  27
 365
 ---
 81
 162
  135
 ----
 9855
```

```
 365
  27
 ---
 730
 2555
 ----
 9855
```

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  213
 9855 (821 3/12 or 1/4
 96
 ---
  24
  ---
   12
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Again, let this question be put for a second example. If 427. li. yield 144. li. profit, what profit will 2496. li. yield, work the question, and you shall finde it will yield 841 $\frac{317.}{427.}$ or 841 7^1——4^2——2^3. that is 841. li. 14. sh. 10. d. q

3
71
17847
359424(841$\frac{317}{427}$ in mony 481—14 -10.qu.
3416
1708
427

l. s. d.

2496
144
9984
9984
2496
359424

In the rule of Three reverſe, or backward, multiplie the firſt and ſecond termes of the rule together, and divide that product by the third term, and the quotient will be the fourth proportionall. But foraſmuch as the rule of Three, as almoſt all other rules of Arithmetick are wrought by Multiplication and Diviſion, either in the whole or in part, therefore ſeeing you are in them ſufficiently inſtructed already, I hope I ſhall not need to proceed any further in ſhewing the uſe of the Rods, in any of the particular rules of Arithmetick; for he that can apply the Rods well and readily to thoſe rules already taught, is able to applie them to any other rules whatſoever, as his occaſion ſhall require. For it is not my intention here to teach and ſet forth the rules and principles of Arithmetick, but the uſe of the Rods in Arithmetick: Such as are unlearned in this moſt excellent Art, and deſire herein to be inſtructed, or in any other part of the Mathematicks, ſhall finde me their ſervant, ready to perform what they ſhall deſire in this particular.

Of

Of Decimall Arithmetick.

NOw for Decimall Arithmetick, the rules thereof are alſo as eaſily wrought by the Rods, as are the rules of vulgar Arithmetick, and in the ſame manner and form, for the Rods are as capable of the one as of the other, as if you would have this number $275\frac{65}{100}$ that is to ſay, 275. $6.^{1}$ $5.^{2}$ to be multiplied by, or into $154\frac{52}{100}$ or which is all one 154. $5^{1}-2^{2}$ here Tabulate 100. the number 27565. as if it were a whole number, and then write down the multiplicator 15452. as if it were an abſolute whole number, for ſo in ſhew it is. Then take the ſimple, the quintuple, the quadruple, the quintuple againe, and the Duple of the Multiplicand 27565. the number Tabulated, or if you Tabulate the other

15452	27565	27565.
27565	15452	15452.
30904	27565	55130
108164	137825	137825
77260	110260	110260
92712	137825	137825
77260	55130	27565.
425934380.	425934380	425934380.

number

number 15452. and then take the duple, the ſeptuple, the quintuple, the ſextuple, and laſtly again the quintuple, and ſet theſe ſeveral products one beneath another in the ſame order before taught in Multiplication, and adde them all together, the product will be 42593|4380. from whence by a daſh with your Pen, cut off four places of figures, becauſe that in both numbers, are four fractionall figures, and then the product will be $42593\frac{4380}{10000}$. or 42593.4 primes, 3 ſeconds, 8 thirds.

Again, let this queſtion be propounded: If $45.\ 7^1\ 5^2$ give $26.2^1\ 5^2$ what will $345.\ 5^1\ 5^2$ give? work the queſtion according to the rule of three, and your anſwer will be 198|36. that is 198. 3 primes, 6 ſeconds; behold the work, where having multiplied the third term by the ſecond,

34555	3
2625	123
172775	37809
69110	4495132
207330	90706875(198.36
69110	4575
9070.6875	41175
	36600
	9150
	27450

the

the product is 9070 6875. whereof the four lowermoſt figures are fraction figures, this product divided by 45.75 giveth in the quotient 19836. and becauſe your dividend had four places of fractions, your quotient will have two, therefore 36. the two loweſt figures of the quotient, are fraction figures, being the numerator of ſuch a fraction as hath for his denominator an unite with two Cyphers, in this manner $\frac{36}{100}$ and ſo the quotient is $198\frac{36}{100}$ or 198. 3. primes. 6 ſeconds.

Again, I have a piece of land to ſurvey, whoſe length is $76\frac{1}{2}$ Perches, and is expreſſed by Decimall, thus, 765. the bredth of the ground is $47\frac{3}{4}$ and in Decimals is thus expreſſed in whole numbers 4775. theſe two numbers multiplied together, give for their product 3652875. whereof the three lowermoſt figures 875. are fraction figures, which cometh to paſſe, becauſe in the two numbers multiplied together, were three places of fraction figures: and ſo the content of that piece of land is 3652. Perches, and ſomething above three quarters, but by the vulgar way of working, it is but 3652. and an half; this product 3652875 divided by 160. giveth in the quotient 22. Acres, 3. Roods, 12. Perches and an half, the content of the field that was required to be ſurveyed, behold the work.

4775
765
23875
28650
33425
3652875.

15
434
3652875 (22.830 (22-3-12½
1666660
1111

Or you may divide it at twice, first by 40. next by 4. & the work wil be all one and the same, only one may be more easie then the other. In like manner all the rules of Decimall Arithmetick are performed upon the Rods, as the old vulgar Arithmetick is, by only but observing to deale with your fractionall parts when your worke is ended, according as you be taught in the books and rules of Decimall Arithmetick, and therefore seeing that the thing is so easie to be understood, I will not trouble my selfe and the Reader with any more words thereabout, but commend these excellent vocall Rods, with my simple, rude, and unpolliſhed notes upon their use, to the judicious censure of the understanding Practitioner.

CHAP.

CHAP. X.

An Appendix concerning the back of the Frame.

VPon the back ſide of the frame wherein the Rods are Tabulated, may be made an inſtrumentall Table, whereby with eaſe may be wrought Addition, Subſtraction, Multiplication, and Diviſion. And for that I finde ſome men are delighted with thoſe inſtrumentall works, as well for their recreation, as for profit, I have briefly in few words added this following conceit, for ſuch as will, to make uſe of, and it is eaſily thus made.

Divide the back ſide of the frame the narroweſt way, into eleven equall parts, and draw paralell lines by thoſe diviſions through the length of it, whereof the uppermoſt diviſion or ſpaces, are for the Denomination of the places below, in the other ten ranks or diviſions, then divide the ſame again the longeſt way into 12. 13. or 14. or what number of diviſions you pleaſe, and by thoſe

thoſe diviſions draw paralell lines from ſide to ſide, ſo ſhall you have a number of little ſquares made, in which ſtamp figures, in this manner. In all the ten Collumes, or lines of ſquares next the left hand, ſet down the nine ſingle digits, and the 0. thus, 1.2.3.4.5.6.7.8.9.0. as you ſee in the figure thereof here drawn. In the upper ſpace over the head of each of the ten lines of ſquares, are ſet letters, for the more ready diſtinction of the Denomination of the places. The two lines of ſquares below the uppermoſt duple line under the letter S. are for ſhillngs, whereof the uppermoſt is for tens of ſhillings, the next for unites of ſhillings, then below the loweſt duple line, in one line, and part of the next, under the letter D. are ſet the pence of a ſhilling from 1. to 11. and in part of the loweſt line next the right hand under the letter Q. are ſet the farthings of one peny. In every of the ſquares on the Table, make a ſmall hole, and then prepare about ſome 12. wire pins of Braſſe, made fit to go into thoſe holes, theſe ſerve to expreſſe, and ſet forth any number on the Table; behold the figure, and it will inſtruct better then many words. You may if you pleaſe lay a white ground upon the back of the frame, or colour it over with any colour you pleaſe, and then make the lines and figures of a contrary colour, thus is your Inſtrument ready for uſe.

How to work Addition by this Inſtrument.

FOr an Example, let there be given theſe five numbers to be added together, firſt ſet down upon your Table the firſt of them, *viz.* 546734. in this manner, beginning if you will with the loweſt place firſt, ſet one pin in the ſquare of 4. in the place or line of Units, next ſet one pin in the ſquare of 3. in the place, or line of tens; then for the ſeven in the third place, which is the place of hundreds, ſet one pin in the ſquare of 7. and for 6. in the fourth place, the place of thouſands, put a pin in the ſquare of 6. in the ſame fourth line of ſquares, put another pin in the ſquare of 4. in the fifth line of ſquares, and laſtly, put another pin in the ſquare of 5. in the ſixt place, or line of ſquares, which is the place of 100000. and ſo you have your number 546734. repreſented, and ſet forth upon the Table by theſe ſix pins.

546734	
234567	
12510	
2142	
379	

Now to adde the ſecond number 234567. to this, beginning if you will, with the loweſt place next the right hand, ſay 4. and 7. is 11. to expreſſe which, firſt remove the pin in 4. to 1. in the ſquare of 1. then 1. for 10. I beare in minde, with the 3. on the table in the place of tens, is 4. and that with 6. in the ſame place of tens in your ſecond number, is 10. now remove the pin from the ſquare 3. to the ſquare 0. and beare 1. this 1. that you beare, and 7. in the place

place of hundreds on the Table is 8. which with 5. in the ſame place of hundreds, in that ſecond number maketh 13. therefore remove the pin in the ſquare 7. in the hundred place to the ſquare 3. in the ſame place, and beare 1. this 1. with the 6 in the thouſand place, is 7. which with 4. in the ſame place in the addible number is 11. remove the pin in 6. in the place of thouſands to 1. in the ſame place, and beare 1. this 1. with the next figure 4. in the place of 10. thouſand is 5. and with the 3. in that place of the addible number is 8. remove the pin in 4. to 8. in the ſame line or place, bearing nothing, becauſe the ſame doth not amount to 10. Laſtly, 5. in the line or place of 100. thouſands with the 2. in your addible number is 7. therefore remove the pin from the ſquare 5. to the ſquare 7. in the ſame line, and you have added together the two firſt numbers of the five given numbers, and the ſumme of them both is repreſented by the 6. pins on the table, and is 781301. to which number adde your third number given 12510. and the ſumme of them will be 793811. for firſt, 1. and 0. is but 1. therefore let the firſt pin ſtand without removing, then 0. in the ſecond place of your tabulated number, and 1. in the ſecond place of the ſaid third number is alſo 1. therefore remove the pin in 0. in that ſecond place, to 1. next 3. on the table, in the place of hundreds, and 5. in the ſame place, in the third number is 8. remove

the

the pin in 3. to 8. then in the fourth place, the 1. on the table, and 2. in that place of the addible number is 3. the pin in that fourth place remove frō 1. to 3. next in the fifth place the figures 8. & 1. is 9 remove the pin in that fifth place from 8. to 9. and ſo is the third number added to the other two, for there being nothing to be added to 7. in the higheſt place, that pin muſt ſtill ſtand as it doth, and the ſumme of the three numbers is ſet forth by the pins upon the table to be 793811. To this adde the fourth given number according as you did the other, and the ſumme of them will be 795953. Laſtly, to this ſumme adde the firſt number, ſaying, or conceiving in your mind, thus, 3. in the loweſt place of the Table, and 9 in the loweſt place of the ſaid fifth number, is 12. remove the pin from 3. in that place to 2. and bear 1. that 1. with 5. in the ſecond place of the tabulated number is 6. and this 6. with the 7. in the ſecond place of the ſaid fifth number is 13. remove the pin in the ſame ſecond place from 5. to 3. and bear 1. for the 10. to the third place, and ſo proceed on with the reſt of the figures, and at laſt you ſhall finde the totall of the five given numbers is repreſented by the 6. pins upon the Table to be 796332. the thing ſought for.

For a ſecond example, let there be given theſe four ſummes of mony to be added together into one ſumme. *viz.* 2796 *li.* 16 *ſh.* 10 *d.* 2 *q.* and 8392 *li.* 10 *ſh.* 4 *d.* 1 *q.* and 765 *li.* 1 *ſh.* 6 *d.* 3 *q.* and

and 574 *li.* 2 *ſh.* 2 *d.* Here as before in the former example, expreſſe upon the Table the firſt number 2796 *li.* 16 *ſh.* 10 *d.* 2 *q.* in this manner, beginning if you will with the higheſt firſt; ſet one pin in the ſquare of 2. in the place of thouſands, becauſe that place is the higheſt in this number, next put a pin in the ſquare of 7. in the place of hundreds, then one in the ſquare of 9. in the place of tens, and another in 6. in the place of units. Now for the 16 *ſh.* put one pin in the place of tens of ſhillings, and another in 6. the loweſt place of ſhillings, next put one pin in the place of 10 *d.* and laſtly, one in the place of 2 farthings, and ſo is your firſt number ſet forth upon the Table by theſe 8 pins.

To adde the ſecond number to this worke, thus, ſay 2 farthings and 1 farthing is 3 farthings, remove the pin in 2 farthings to 3 *q.* then ſay 10 *d.* on the table, and 4 *d.* in the number to be added, is 1 *ſh.* 2 *d.* remove the pin from 10 *d.* to 2. and carry 1 *ſh.* to the 16 *ſh.* making it 17 *ſh.* and the 10 *ſh.* put to that, which is in the addible number is 1 *li.* 7 *ſh.* therefore caſt away the pin in the place of 10 *ſh.* and remove the pin in 6. to 7. and carry 1. to the places of pounds, and ſay 1 *li.* that I bear, and 6 *li.* on the table is 7. and 2. in the addible number is 9 *li.* therefore remove the pin from 6. to 9. in the place of unites of pounds, then ſay 9. and 9. is 18. remove the pin in the place of tens of pounds, from 9. to 8. and bear 1. this 1. and 7 in the

ſeventh ſquare of the third place is 8. and the 3. in the ſame third place of the addible number is 11. therefore take the pin in 7. and put it in 1. and beare 1. for the ten to the next place, this 1. and 2. in the fourth place of the Table is 3. and the 8. in the fourth place of the addible number is 11. and ſeeing there is no more places to be added, therefore ſet down all the 11. by removing the pin in the ſame fourth place from the ſquare 2. to 1. then put a new pin in 1. in the fifth place, the place of tens of thouſands, and the worke is ended, and the totall of theſe two numbers is 11189 *li.* 7 *ſh.* 2 *d.* 3 *q.* To this ſumme adde the third number, according as you added theſe two, and their totall will be found 11954 *li.* 8 *ſh.* 2 *d.* and to this adde the fourth number, and then the totall ſumme will be 12528 *li.* 10 *ſh.* 11 *d.* 2 *q.* After this manner proceed continually, adding one number after another, how many ſoever you have.

Subſtraction.

LEt 7632 *li.* 9 *ſh.* 7 *d.* be a number, out of which is to be ſubſtracted this ſumme 2846 *li.* 16 *ſh.* 8 *d.* and the remainder required. Firſt, ſet forth on the Table the greater number out of which Subſtraction is to be made, now to do the worke, if you will begin at the right hand, according to the uſuall way, then ſay 8. out of 7 *d.* cannot be, therefore borrow 12 *d.* and take

take 8 *d.* out of it, and there remaineth 4. this 4 *d.* and 7 *d.* is 11 *d.* remove the pin from 7 *d.* to 11 *d.* then for the 12 *d.* that was borrowed, adde 1 *ſh* to 16 *ſh.* and it is 17 *ſh.* take 17 *ſh.* out of 9 *ſh.* cannot be, therefore borrow 20 *ſh.* and make it 29 *ſh.* out of which take 17 *ſh.* and there reſteth 12 *ſh.* remove the pin from 9 *ſh.* to 2 *ſh.* & put a new pin in one of the places of 10 *ſh.* for the 10 *ſh.* and ſo is repreſented the 12 *ſh.* remaining; well, next for the 20 *ſh.* that was borrowed, adde 1 *li.* to the 6. that is in the loweſt place of the number to be ſubſtracted, and it is 7 *li.* to take 7 *li.* out of 2 *li.* cannot be, therefore by borrowing 1. take 7 out of 12. reſteth 5. remove the pin in that ſquare of 2. in the place of units, from thence to 5. then for the 1. or 10 that was borrowed, and 4. in the next place is 5. which cannot be taken out of 3. therefore borrowing 1. or 10. take 5. out of 13. reſteth 8. remove that pin in the place of tens of pounds, from 3. to 8. now that 1. that was borrowed payed to 8. in the 3 place is 9. which is alſo too big to be taken out of 6. therefore by the rule of borrowing, borrow 10. to 6. and it is 16. from whence take 9. and 7. will remaine, and thereupon remove the pin in the third place from 6. to 7. Laſtly, 1. that was laſt borrowed, added to the 2. in the fourth and laſt place is 3. take this 3. from 7. and there will reſt 4. remove therefore the pin from 7. to 4. and the worke is ended, and the number remaining

is repreſented on the Table to be 4785 *li.* 12 *ſh.* 11 *d.* which is the thing that was required. In this manner may any other ſumme be taken from another, by helpe of this Table, and if many ſummes be to be taken from one, firſt take one, and then from the remainder take another, and from that remainder take another, and ſo from one to one, untill they be all taken from thence, that you deſire, and the remainder will appeare at the laſt.

Multiplication.

LEt this number 3745. be a number given, and if it be required to be multiplied by 364. to performe this by the Table, firſt ſet forth upon the Table the multiplicand 3745. then multiply it by every figure of the multiplicator, beginning with which figures you will firſt, either the higheſt or the loweſt, for you may worke which way you beſt pleaſe, but beginning with the firſt next the right hand, ſay, 4. times 5. is 20. therefore remove the pin that ſtandeth in 5. to 0. in the ſame line, and beare 2. for the 20. then ſay 4. times 4. is 16. and 2 born is 18. remove the pin from the 4. in the ſecond place to 8. in the ſame line or place, and bear 1. for the 10. then next ſay 4. times 7 is 28. and one that is born, is 29. therefore that pin that ſtandeth in 7. ſet forth to 9. in that third place, and bear 2. then

then ſay 4 times 3 is 12. and that 2 is 14. now being there be no more figures to be multiplied by 4. ſet forth all the 14. by ſetting that pin which ſtood in 3. to 4. and putting a new pin for the 10. in 1. in the next higher place, and then the ſumme of 3745 multiplied by 4. will appeare ſet forth upon the Table to be 14980.

Now next you are to multiply 3745. by 6 which to do, ſay ſix times 5. is 30. this 30 muſt be ſet in order, one place higher towards the left hand, that is, as much as to ſay, adde the 0. being the loweſt place to 8. in the ſecond place of the number on the Table, and it is ſtill but 8. ſo here is no action to be done upon the Table, but bear 3. in mind for the 30. then ſay next, ſix times 4. is 24 and 3. in mind is 27. this 27. and the 9. in the third place of the Table is 36. remove therefore the pin in that third place from 9. to 6. bearing 3. and ſay againe, ſix times 7. is 42. and 3. born is 45. and with the 4 in the fourth place is 49. remove the pin in that fourth place from 4. to 9. and bear 4. then laſtly ſay, ſix times 3. is 18. and the 4. born is 22. and that with 1. in the fifth place of the Table is 23. ſet down all the 23. by firſt removing the pin in the fifth place from 1. to 3. and putting a new pin in 2. one place higher, that is, in the ſixth place of the Table, & ſo the product of the multiplicand multiplied by thoſe two figures is ſet forth to be 239680. now for the third and laſt figure of the multiplicator, ſay three times 5. is 15. which with 6. in the third

place is 21. remove therefore the pin from 6. to 1. in that third place of the Table, and beare 2. for the 20. to the next place, and there ſay, three times 4. is 12. and 2. that you beare is 14. and 9. in the fourth place is 23. remove the pin in the fourth place from 9. to 3. and beare 2. to the next place, and there ſay, three times 7. is 21. and that 2. in minde is 23. and that together with the 3. in the fifth place is 26. remove the pin in that place from 3 to 6. and ſtill bear 2. to the laſt place, where ſay, 3. times 7. is 9 & the 2. that is born is 11. and 2. in the ſixth place of the Table make 13. which ſet forth all upon the Table, by reaſon you have now done with all the figures of the multiplicand, ſetting the pin in the ſaid ſixth place from 2. to 3. and then put a new pin in 1. a place higher, and then the number ſet forth upon the Table will be 1363180. which is the product of 3745. multiplied by 364. and ſo the queſtion demanded is anſwered.

You may worke your multiplications by this Table, without bearing any thing in minde, by only removing two pins, when by this former way you remove but only one at a time, and ſo you may worke from the right hand to the left, or from the left to the right, as you pleaſe; thoſe that deſire to make uſe of this Table, may eaſily apprehend the uſe of it, without many words of inſtruction, whereof I deſire to be ſparing, becauſe this is over and beſide my intention.

Diviſion.

Diviſion.

LEt 28642. be a number given, and if it be required to divide it by 426. Firſt, upon the Table ſet forth the dividend 28642. then examine how often you may have the diviſor 426. in the four higheſt figures of the dividend, for in the three higheſt you cannot have them once, for they are but 286. and you ſhall ſoone ſee that you may have the diviſor in them foure figures ſix times, therefore ſay, ſix times 4. is 24. take 24. out of 28. and 4 remaineth, therefore caſt away the higheſt pin next the left hand, and remove the next pin in the next place from 8. to 4. in the ſame place, ſo have you done with your firſt figure, then ſay, ſix times 2. is 12. take this 12. out of 46. his proper figures, and there will remaine 34. therefore remove the higheſt pin from 4. to 3. and the next from 6. to 4. in his line; Laſtly ſay, ſix times 6. is 36. out of 44. reſteth 8. now therefore not medling with the higheſt pin in the fourth place, remove the next from 4. to 0. in his owne line, and the ſecond pin remove from 4 to 8. in his owne place, and thus have you gone through all the places or figures of the diviſor, and muſt begin againe one place lower, ſeeking how often you may have the diviſor 426. out of the number 3082. now left, ſet forth upon the Table,

and you ſhall finde you may have it only ſeven times; ſay therefore, firſt, how many times 4. in 30. it may be 7. times, therefore take 28. the ſum of 7. times 4, from 30. and 2. remaineth, caſt away the pin in 3. in the higheſt place, and remove the pin in 0. in the next place to 2. in the ſame place, againe ſay, ſeven times 2. is 14. and that taken out of 28. his reſpective number, reſteth 14. therefore remove the higheſt pin in the third place, from 2. to 1. and that in the ſecond place from 8. to 4. Laſtly ſay, ſeven times 6. is 42. and that taken out of 42. its reſpective number, leaveth 0. 0. in the places thereof, remove therefore both the lower pins down from their places 4 & 2. where they ſtand, and ſet them in 0. and 0. & your diviſion is ended, and the quotient in whole numbers is 67. and an 100. remaineth, ſo then the true quotient of 28642. divided by 426. is $67\frac{100}{426}$ And ſo much for Diviſion, and for the uſe of this Inſtrument.

FINIS.

Errata.

Page 4. line 20. for right, reade right hand. p. 23. l. 23. f 7595. r. 5376 p. 33. l. 17 f. 2033910. r. 20339410 p. 71. at the end of the ſecond line after is, r. the.

Arithmetick.

- In whole Numbers and Fractions.
- Decimall Arithmetick.
- Extraction of Roots, Square and Cube.
- Aſtronomicall Fractions.
- Æquations, with Coſſe, or Algebra.
- The Arithmeticall Rods, and Arithmeticall Jewell.

Geometrie.

- The Principles, with practiſe and Demonſtration, meaſuring of any ſuperficiall, or ſolid content, as Board, Glaſſe, Timber, Stone &c.
- The Gauging of Veſſels.
- The meaſuring of Land, and making, and reducing of Plots and Maps to any proportion deſired.
- The uſe of ſundry Inſtruments, as Plaine-table, Circumferenter, Theodilit, Circuler ſcale, Quadrant, Semicircle, Peractor, Sector, Circles of Proportion, and Mr. *Wingats* Lines of proportion, a moſt excellent Inſtrument in all Mathematicall practices.

Trigonometria.	The uſe of the Tables of Logarithmes, Signes, Tangents, and Secants.
	The meaſuring of Heighths, Depths, Lengths and Diſtances.
	The Doctrine of Triangles, Plaine and Spherical.
Navigation.	The Principles thereof, with uſe of the Inſtruments, Maps, and Charts fitting that Art.
Coſmography.	The uſe of the Globes, Sphere, Aſtrolabe, and Mathematicall Jewell.
Dialling.	Both Fixed and Inſtrumentall.

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